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The purpose of this book is to instill in the reader an understanding of the nature and management use of cost and other economic data. Particular emphasis is placed upon the *internal* development and use of cost data for analysis, planning, and control within the firm. Careful consideration is given to the business setting in which cost measurements and analyses are made. In this respect the book is *managerial* in nature.

An understanding of the debit and credit model, typically included in the first course in accounting, is presumed. After the necessary explanation of cost data accumulation, an *analytical* rather than a mechanical-procedural approach is used wherever possible. In this second respect the book is managerial.

The text discussion moves logically from the brief preliminary overview of cost concepts to the final extended discussion of the use of costs in management decision making. Specifically, the pattern is as follows:

1. An overview of cost concepts upon which cost analyses and reports are based (Chapters 1 and 2)
2. The development of accounting costs and cost systems
  - a. The development of accounting costs by element of cost—material, labor, and factory overhead (Chapters 3, 4, 5, and 6)
  - b. Elements of cost and cost accounting systems, or models (Chapters 7, 8, and 9)
  - c. The philosophy and construction of standard costs, analyses of variances, and their use in control (Chapters 10 and 11)
3. The use of costs in performance evaluation and profit planning
  - a. The interrelationship of cost, volume, and profit (Chapters 12 and 13)
  - b. The relationship of costs to intracompany pricing, return on capital analyses, and performance evaluation (Chapters 14 and 15)
  - c. The influence of costs in profit planning, and variations from the profit plan (Chapter 16)
4. The use of costs in management decision making
  - a. The use of costs in *pricing* decisions (Chapter 17)
  - b. The role of costs in *capital-investment* decisions (Chapter 18)
  - c. *Distribution* cost analysis (Chapter 19)
  - d. Costs and *production* decisions (Chapter 20)

The book's structure of overview, buildup of costs and their use in performance evaluation, profit planning, and decision making permits the user to go as far in the book as the objectives of the course, the level and interests of students, and the instructor's preferences indicate.



The user may be selective about the chapters employed. For a preliminary one-term cost course the professor may wish to utilize Chapters 1 through 11 and then, if time permits, choose various chapters from Chapters 12 through 20. For two one-term courses the book may be divided conveniently into Chapters 1 through 11 and 12 through 20.

For a single one-term advanced course, such as managerial accounting or controllership, the professor may wish to utilize Chapters 1 and 2 and then some of Chapters 11 through 19. During the past six years, the material in these latter chapters also has been used in executive development programs and has been well received by participants.

This book was written to satisfy the need for a cost accounting book which would clearly indicate the appropriate cost data for various specific purposes and their role in the management of a business. In addition, economic theories are discussed, especially in the later chapters, in an effort to integrate them with accounting cost theories. Relevant concepts from other areas of business knowledge are introduced to stress the general significance of cost data. The limitations of cost measurement in its present state of development are indicated throughout the book.

We have sought to present the traditional cost data accumulation material in a more concise manner and to emphasize the managerial use of data with greater depth and breadth than usual. The problems and cases at the ends of chapters have been organized with sufficient flexibility to accommodate the needs of individual teaching situations.

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# **1. An Introduction to Cost Accounting and Cost Concepts**

In this chapter, an overview of cost accounting and cost concepts is presented. This discussion is intended to provide a background and frame of reference for the more extensive coverage of the material in subsequent chapters.

## *The cost accounting function*

### **Cost accounting and financial accounting**

Financial accounting is concerned with two fundamental objectives, namely, reporting the nature and status of the capital invested in a firm (balance sheet) and measuring changes in capital resulting from operating activities (income statement). The balance sheet indicates the extent to which a firm's management has conserved the properties with which it has been entrusted. The income statement discloses the extent to which these resources were gainfully employed during a specified period of time. The accounts maintained, the financial transactions recorded, and the reports issued in conjunction with these objectives conform to established principles of accounting.

Business income is measured by matching the costs of products with the revenues derived from their sale. The cost accountant contributes to the realization of this financial accounting objective by establishing and maintaining systems which provide product cost data which are used in the matching process of income determination. The cost of unsold inventories at the end of a period are carried forward on the balance sheet. Hence, the product cost data prepared by the cost accountant affect the balance sheet as well as the income statement.

In order to accumulate product cost data, the cost accountant maintains special records and accounts which in aggregate are referred to as a *cost accounting system*. The characteristics of cost accounting sys-



tems differ according to the nature of the activities engaged in and the objectives of management. The cost accounting system is not independent of the financial accounts. Rather, it is integrated into, and merely represents an elaboration of, the basic financial accounting system. Through these cost records, the cost accountant is able to contribute to another financial objective, namely, control over the resources of a firm. The cost accounting system is directly concerned with control of inventories, plant assets, and funds expended on functional activities.

### Objectives of cost accounting

Cost accounting is concerned with the classification, accumulation, control, and assignment of costs. The cost accountant classifies costs according to patterns of behavior, activities or processes to which they relate, products to which they attach, and other categories, dependent on the types of measurements desired. Costs may be accumulated by accounts, jobs, processes, products, or other business segments. From these data, the cost accountant calculates, reports, and analyzes the cost of performing different functions such as the operation of a process, the manufacture of a product, and special projects undertaken. He also prepares data which assist management to establish plans and to select between alternative courses of action.

In general, costs which are collected in the accounts serve three principle purposes:

1. They provide cost data for income measurement and inventory valuation (income statement and balance sheet).
2. They provide information for management control of the firm's operations and activities (control reports).
3. They provide information for management planning and decision making (special analyses and studies).

The formal cost accounting system generally provides cost data and reports for the realization of the first two of these objectives. However, for management planning and decision-making purposes, these data ordinarily must be reclassified, reorganized, and supplemented by other relevant economic and business data from outside the formal cost accounting system.

### Manufacturing firms and trading firms

Merchandise traders and distributors such as retailers and wholesalers purchase finished goods which require no further factory processing. Goods on hand at the end of an accounting period are described as *finished goods inventory*, or, perhaps more frequently, as *merchandise inventory*.

Manufacturing firms, on the other hand, purchase raw materials and convert or process them into finished goods. Raw materials which have not as yet been put into production are referred to as *raw materials inventory*. In the factory at any one time, such as at the end of an account-

ing period, there may be materials which are only partially converted into finished goods. This incomplete production and the cost account for it are known as *Work in Process*, or *Work in Progress*. As with trading companies, completed production which is awaiting sale to customers is called finished goods inventory.

Finished goods, or merchandise, which have been *purchased* during the period for resale by traders and distributors are described on their income statements as *merchandise purchases* or simply as *purchases*. Finished goods which have been *manufactured* during the period for resale by manufacturers are described on their income statements as *cost of goods manufactured*.

Although cost accounting is performed in trading companies, the more elaborate cost accounting systems are found in manufacturing companies, where raw materials are converted into finished products. Accounting for the flow of costs in a manufacturing type of activity is far more complicated than in a trading company. Since a trading company does not change the shape or form of its purchased materials, product cost ordinarily is equivalent to purchase price. The major portion of this book will be concerned with the cost accounting function as applied to manufacturing concerns.

## *The nature of costs*

### **General nature of accounting costs**

Accounting costs emerge from bona fide transactions that generally have legal or contractual roots. "Cost" represents a sacrifice of values. The initial cost of an asset or services acquired is reflected by the cash or other values relinquished or liabilities incurred.

In addition to the acquisition price of an asset, certain other preliminary costs may be incurred to permit the asset to render its expected services. Included in this category are incoming transportation charges on materials and equipment and the cost of installing fixed assets. Established accounting principles require that these expenditures be assigned directly to the cost of the property acquired.

A business incurs costs for the purpose of deriving revenue. A building, delivery truck, or salaried employee represents a service potential which is expected to create or maintain a stream of revenue. Business income is based on a matching of revenue and costs. A major function of cost accounting is the attachment of costs to products manufactured and the matching of these product costs with the revenue derived from their sale.

### **Costs, expenses, and losses**

Costs are to be distinguished from expenses and losses. "Costs" represent that portion of the acquisition price of goods, property, or services

which has been deferred or not yet utilized in connection with the realization of revenue. Fixed assets and inventories are examples of such deferred costs.

"Expenses" are costs which have been applied against the revenue of a particular period. Office salaries are expenses of the period in which they are incurred.

"Losses" are reductions in firm equity, other than from withdrawals of capital, for which no compensating value has been received. Destruction of a plant by tornado or fire is an example of a loss.

### Primary-cost classification

All expenditures or accruals which influence the income statement may be treated in one of three ways:

1. Expenditures may be "expensed," or written off, in the period incurred. Nonfactory expenditures and accruals, i.e., marketing, selling, distribution, and administrative expenses, are treated by accountants in this manner.

2. Expenditures may be "capitalized" as fixed assets, deferred expenses or charges, or other assets and later amortized, depreciated, or depleted. Such charges are (a) "expensed" in the period incurred if they are not

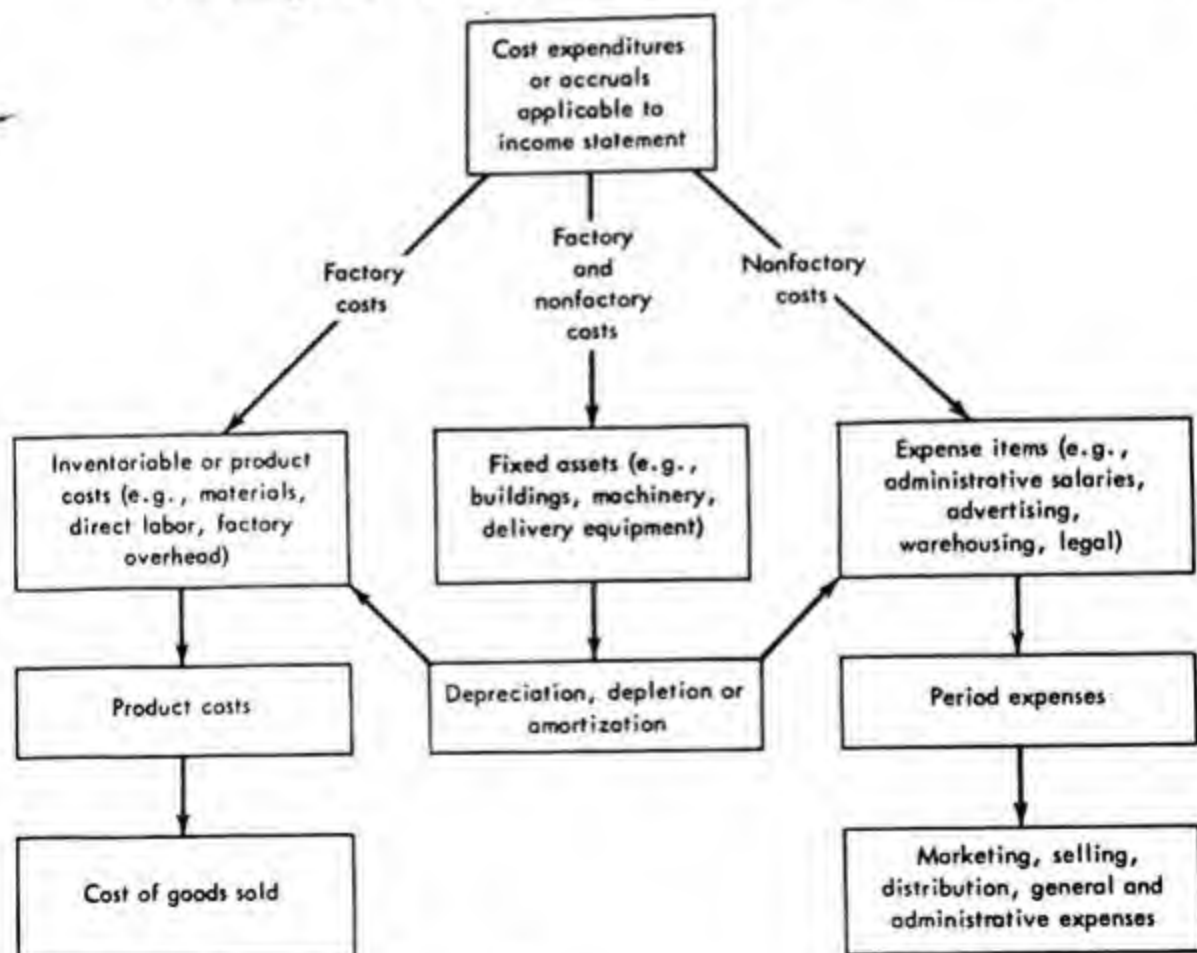


Fig. 1-1 Flow of costs and expenses.

related to production or (b) "inventoried" as a product cost if they are related to production rather than to nonfactory functions. The assigning of depreciation and amortization charges to inventory sets them up again as assets, or capitalizes them.

3. Expenditures may be "inventoried," or treated as product costs which eventually, when sold, become the cost of goods sold item on the income statement.

The flow of these three types of expenditures and accruals into the income statement is traced in Fig. 1-1.

### Elements of manufacturing cost

Cost accounts consist of detailed accounts for the elements of cost which comprise the cost of goods manufactured by an industrial firm. Three general elements of manufacturing cost are usually recognized: *direct raw materials*, *direct labor*, and *factory overhead*. Factory overhead is also sometimes called manufacturing overhead, manufacturing expense, factory expense, burden, and indirect factory costs or expenses. The term "factory overhead" will be used throughout this book. The term "direct raw materials" will be abbreviated to "raw materials."

For product-costing purposes, the adjective "direct" indicates the relationship of these cost elements to the product being produced. Direct materials are raw materials which physically become a part of the finished product. Direct labor is the cost of the services of employees actually working on the product itself, rather than the cost of supervisory or other indirect labor which is somewhat removed from actually working on the product. Raw materials and direct labor often are described as *prime costs*.

Factory overhead includes all costs related to factory production which are not raw materials or direct labor. Three categories of factory overhead may be distinguished: (1) indirect materials, (2) indirect labor, and (3) general factory overhead. Examples of each category of factory overhead are:

1. Indirect materials—lubricating oils, cleaning materials, maintenance and repair supplies, etc.

2. Indirect labor—supervisors' salaries, factory clerks' salaries, watchmen's salaries, maintenance personnel salaries, etc.

3. General factory overhead—depreciation of factory building and equipment, insurance on factory, rent, taxes, utilities, etc.

The combination of direct labor and factory overhead is known as *conversion cost*, or *processing cost*, because these are the costs of converting or processing raw materials into finished products.

### Product versus period costs

Business income  $I$  is derived from a matching process reflected by the equation

$$I = R - C_{pr} - C_{pe}$$



where  $R$  = revenue

$C_{pr}$  = product costs

$C_{pe}$  = period costs

"Product costs" are factory costs which are attached to units manufactured. Product costs are assigned against revenue and become expenses only when products are sold. Until that time, they are held in inventory accounts and appear on the balance sheet rather than on the income statement.

"Period costs" or expenses are of a nonfactory nature and are written off each period as incurred. They include marketing, selling, distribution, research, and administrative expenses.

In general, the greater the proportion of total costs attached to products, the more precise the matching process of income measurement becomes. Why then have accountants traditionally sanctioned the exclusion of nonfactory costs from products? Several explanations may be offered:

1. Nonfactory costs are not as readily identifiable with products as manufacturing costs. While it is relatively simple to associate cost of raw materials used with finished products, it is much more difficult to identify the cost of operating a delivery truck or the time and expense of a salesman with products manufactured.

2. The incurrence of nonfactory expenses, particularly selling, marketing, and distribution, often takes place in point of time after products have been manufactured and inventoried.

3. Nonfactory costs tend to remain relatively constant from period to period or at least do not fluctuate in amount in relation to changing levels of factory production.

4. The treatment of nonfactory costs as inventoriable product costs would result in increased inventory values. Accounting traditionally has been influenced by conservatism. This is reflected in a reluctance to overstate inventories on the balance sheet.

Not all accountants are in agreement with the treatment of nonfactory costs as period costs or expenses. They believe this results in a distortion of income. However, suggested alternatives have gained little support.

The development of product costs is one of the three main objectives of cost accounting. When product costs are known, income statements conform to the matching equation, as shown below:

Revenue obtained during the period (sales).....	XXX
Less: Product costs assigned against revenue (cost of sales).....	XXX
Gross profit.....	XXX
Less: Period costs or expenses.....	XXX
Income for the period.....	XXX

In the absence of cost accounting, which routinely provides product costs, it is necessary to consider beginning and ending physical inventories to determine which product costs incurred during the period are

assignable against revenue and which are applicable to unsold inventories. In this case, the income statement assumes the form shown below:

Revenue obtained during the period (sales).....	XXX
Beginning inventories (physical).....	XXX
Add: Product costs incurred during period.....	XXX
Total product costs <i>assignable</i> against revenue.....	XXX
Less: Ending inventories (physical).....	XXX
Product costs <i>assigned</i> against revenue (cost of sales).....	XXX
Gross profit.....	XXX
Less: Period costs or expenses.....	XXX
Income for the period.....	XXX

Some of the merits of a cost system now become apparent. In the first place, taking a physical inventory is a time-consuming and expensive operation. Few businesses can afford to count and cost their entire inventory more frequently than once a year. Yet management requires cost information and income data throughout the year in order to make intelligent decisions.

Secondly, even when a physical inventory is taken, an absence of product cost data requires the use of cost estimates for pricing inventories. Companies lacking cost accounting often resort to estimating their closing inventories on the basis of a presumed gross profit ratio applied to sales, as shown below:

*Assume:*

Last year's gross profit ratio..... 40 %

<i>Product</i>	<i>Finished goods on hand, units</i>	<i>Selling price per unit</i>
A	10,000	\$5
B	8,000	4
C	4,000	6

*Application of Gross Profit Ratio:*

<i>Product</i>	<i>Selling price</i>	<i>Less: gross profit (40%)</i>	<i>Estimated factory cost</i>	<i>Inventory cost</i>
A	\$5	\$2.00	\$3.00	\$30,000
B	4	1.60	2.40	19,200
C	6	2.40	3.60	14,400
Total.....				\$63,600

The use of an estimated gross profit ratio for calculating the cost of finished goods (and work-in-process) inventories is a crude technique

that can lead to serious distortions in reported income. Actual gross profit can deviate from the estimate because of fluctuations in selling prices and costs and changes in the mix of products sold; i.e., some products may be earning a gross profit above or below the average for the company.

### Direct and indirect costs

Costs may be either direct or indirect. A "direct cost" is one which can be directly identified with a process, product, job, or other business segment. An "indirect cost" is one which is not traceable directly to these business segments.

A cost which is direct for one segment may be indirect for another, as shown below:

<i>Cost</i>	<i>Direct to</i>	<i>Indirect to</i>
General corporate accounting.....	Company	Divisions, plants, departments, jobs, and products
Division management.....	Company, division	Plants, departments, jobs, and products
General plant costs.....	Company, division, plant	Departments, jobs, and products
Direct departmental overhead.....	Company, division, plant, department	Jobs and products

Indirect costs become *allocated costs*, since they must be assigned, allocated, or applied to processes, products, jobs, or other business segments. The allocation of indirect costs involves the use of a base, or index, which reflects the manner in which the indirect cost is presumed to be utilized by these different segments. For example, plant depreciation may be allocated to departments within the plant on the basis of space occupied.

Since the selection of a particular base for allocating costs is to a large extent judgmental, the greater the proportion of total costs that can be classified as direct, the more precise the costing becomes. From a control standpoint, those costs which are directly chargeable to a segment also generally are controllable by the manager of the segment.

Exhibit 1-1 shows how costs which are direct in relation to one segment of a factory become indirect in relation to another. In the illustration, it is assumed that the factory consists of two producing departments and a single service department. In large factories, there may be many producing and service departments, depending on the functions performed and the organization structure of the plant. Products are manufactured in producing departments. Service departments render service to the producing departments. They may include such activities as a

## Exhibit 1-1

## Direct and Indirect Factory Costs

	Producing Dept. X	Producing Dept. Y	Service Dept. Z
<b>Direct costs:</b>			
Raw materials.....	\$5,000	\$3,000	-0-
Direct labor.....	3,000	4,000	-0-
<b>Factory overhead:</b>			
Indirect labor.....	500	600	\$ 800
Supplies.....	900	1,400	700
Depreciation—machinery.....	300	200	100
Total direct costs.....	\$9,700	\$9,200	\$1,600
<b>Indirect costs:</b>			
Factory overhead (allocated):			
Plant depreciation, insurance, taxes, etc.....	250	310	90
Building maintenance.....	80	100	25
Utilities.....	150	190	80
Administrative services.....	1,620	2,000	205
Allocated service department.....	800	1,200	\$2,000
Total cost of producing departments.....	\$12,600	\$13,000	
	Job 1      Job 2		
<b>Direct costs:</b>			
Raw materials.....	\$1,800	\$1,200	
Direct labor.....	2,400	1,600	
<b>Indirect costs:</b>			
Factory overhead.....	3,600	2,400	
Total job costs.....	\$7,800	\$5,200	

machine shop, power plant, cost accounting department, or building services.

In Exhibit 1-1, it will be noted that raw materials and direct labor and certain of the factory-overhead costs are direct charges to the three departments and that other overhead costs are indirect and allocated to these departments. The service department costs, consisting of both direct and indirect charges, are allocated to, and become indirect costs of, the producing departments.

During the period, it is assumed that two jobs were worked on in Producing Department Y. The total departmental cost is assigned to these jobs. Raw materials and direct labor can be directly identified with jobs and become direct job charges. Factory overhead, on the other hand, consists of indirect job costs and must be assigned or applied to jobs. It will be noted that in Department Y the total overhead (\$6,000)



amounts to 150 percent of the direct labor (\$4,000). This *overhead rate* is used to apply the total departmental overhead to the different jobs worked on. In the case of job 1, this results in an *overhead application* of \$3,600 ( $150\% \times \$2,400$ ).

### Unit product costs

Normally, the unit cost of a manufactured product is derived by cost accountants through an averaging process. This *average unit cost* is calculated by dividing the total costs incurred during a specified period by the number of units produced. This is illustrated for product X in Exhibit 1-2.

In Exhibit 1-2, \$93 is called either the average total product cost per unit, the averaged manufacturing cost per unit, or simply average total unit cost. Because unit costs ordinarily are averages, the term "average" is dropped in common usage. Thus, material cost per unit is \$29, and direct-labor cost per unit amounts to \$34.

Unit costs discussed here are in terms of product or output units. Unit costs also may be expressed in terms of input units such as material costs per unit of material (pound, ton, piece, etc.), labor cost per hour, or factory cost per hour.

### Exhibit 1-2

**PRODUCT X**  
Calculation of Unit Cost  
For Week Ended March 24  
Units Produced: 1,000

	Total costs incurred	Cost per unit
Raw materials:		
Item a.....	\$ 8,000	\$ 8
Item b.....	21,000	21
Total.....	\$29,000	\$29
Direct labor:		
Operation 1.....	\$20,000	\$20
Operation 2.....	14,000	14
Total.....	\$34,000	\$34
Factory overhead:		
Indirect labor.....	\$12,000	\$12
Supplies.....	8,000	8
Depreciation.....	6,000	6
Insurance.....	1,000	1
Taxes.....	1,000	1
Utilities.....	2,000	2
Total.....	\$30,000	\$30
Total costs.....	\$93,000	\$93

### Variability of costs

Costs not only may be directly or indirectly related to jobs, products, or processes but also may vary differently in total amount with changes in output or sales. Some costs tend to increase or decrease, in total, in proportion to changes in levels of activity. These are called *variable costs*. Direct labor and raw materials are examples of variable costs.

Other costs tend to vary with time rather than with activity levels. These are referred to as *fixed costs*. Three broad types of fixed costs may be distinguished:

1. Long-run capacity costs. These are the costs of a company's facilities. They represent the existing capacity to produce and sell goods. Depreciation and amortization are fixed costs in this category.

2. Operating fixed costs. These fixed costs are needed to operate the company's facilities. Insurance, taxes, supervision (when fixed) are examples of this type of fixed cost.

3. Programmed fixed costs. These are fixed costs, not directly related to facilities and their operation, to which management has committed the company. Research and advertising are examples of costs of this type.

A third category of costs is partially fixed and partially variable and is referred to as *semivariable costs*, or *semifixed costs*. Semivariable costs have different patterns of behavior. Some tend to remain constant in total amount for ranges of output and then increase or decrease as another range is reached. A single supervisor may be required for from 1 to 20 workers, whereas two are required for from 21 to 40 workers. Other semivariable costs tend to increase in total amount in a curvilinear fashion with rises in output. Electricity tends to increase but at a declining rate, whereas repairs often rise at an increasing rate, as production is increased.

The distinction between fixed, variable, and semivariable costs is not always dependent on the natural characteristics of the costs. Management decisions affect the distinction. For example, if company policy is opposed to discharging supervisors, this becomes a fixed cost. The distinction also depends on the nature of the company's activities. In some highly automated companies even direct labor might be regarded as a fixed cost by management.

In accounting, the general behavior of total and unit fixed and variable factory costs, with changes in output, is as shown in Exhibit 1-3. Semivariable costs have been excluded, since in practice accountants generally classify semivariable costs as either fixed or variable, depending on their predominant characteristic.

The same data are presented graphically in Figs. 1-2 and 1-3. In Fig. 1-2, it will be noted that total fixed factory costs remain constant regardless of the number of units produced. Total variable costs increase in linear fashion, i.e., in direct proportion to changes in output. The line

**Exhibit 1-3****Cost Behavior in Accounting**  
(In total and unit costs)

<i>Units produced</i>	<i>Total fixed costs</i>	<i>Total variable costs</i>	<i>Total costs</i>	<i>Average fixed cost per unit</i>	<i>Average variable cost per unit</i>	<i>Average total cost per unit</i>
1	\$500	\$ 200	\$ 700	\$500	\$200	\$700
2	500	400	900	250	200	450
3	500	600	1,100	167	200	367
4	500	800	1,300	125	200	325
5	500	1,000	1,500	100	200	300
6	500	1,200	1,700	83	200	283
7	500	1,400	1,900	71	200	271
8	500	1,600	2,100	63	200	263
9	500	1,800	2,300	56	200	256
10	500	2,000	2,500	50	200	250

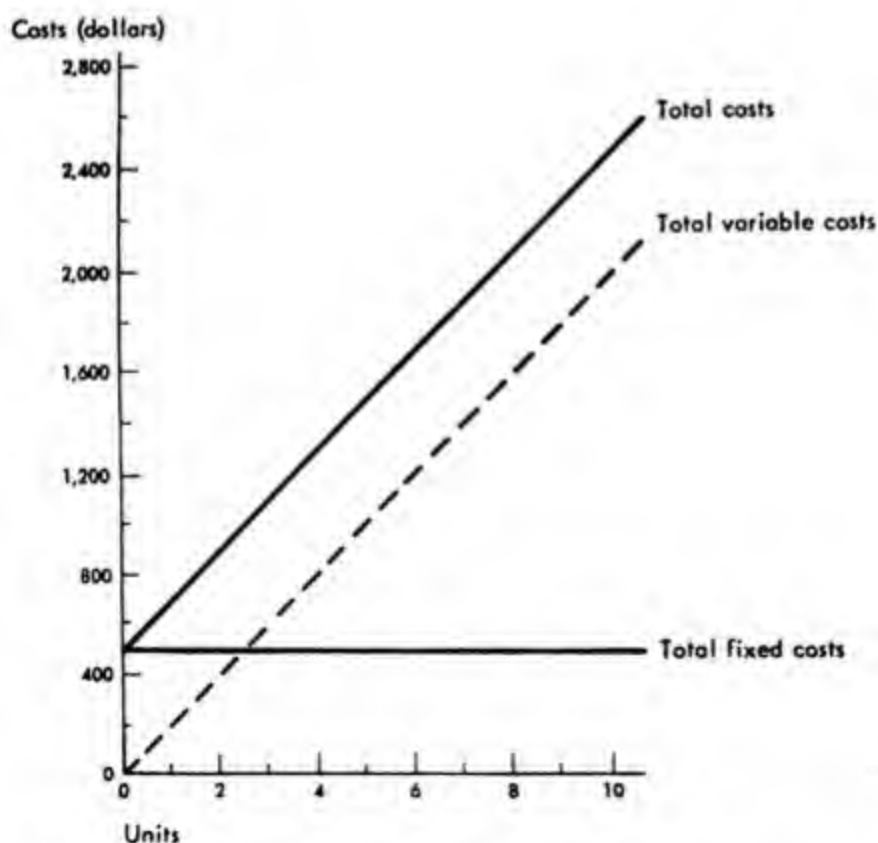


Fig. 1-2 Cost behavior in accounting (in terms of total costs).

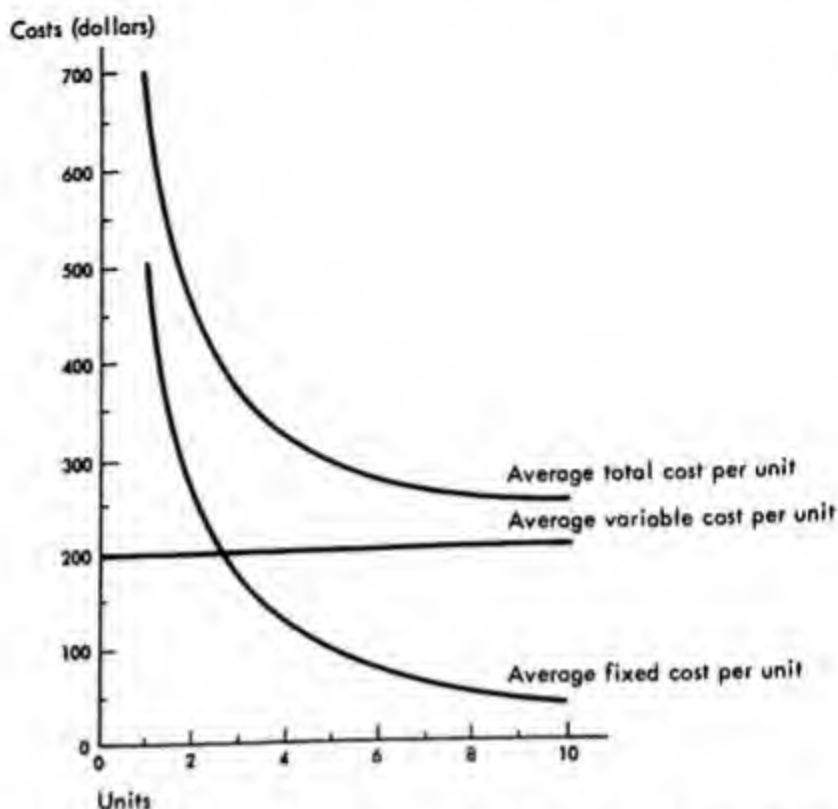


Fig. 1-3 Cost behavior in accounting (in terms of unit costs).

for total costs starts at the amount of the fixed costs (\$500) at the start-up point, i.e., 0 production, since even if the plant is shut down temporarily, the fixed costs will continue. The rate at which the total-cost curve rises is equal to the variable cost *rate* per unit of output (\$200).

In Fig. 1-3, it will be seen that the line for variable unit costs is constant and the line for fixed unit costs declines, more sharply at low levels of output, where the effect of added units on fixed costs is greatest, and less so at high levels. The total cost per unit also shows a sharp decline at lower levels because of the influence of fixed costs.

A knowledge of the variability of costs is essential, not only to cost accountants, but to all business executives. It is of the essence in profit

#### Exhibit 1-4

##### Cost-Volume-Profit Relationships

Sales .....	\$100,000	\$120,000	\$140,000	\$160,000
Costs:				
Variable .....	\$ 60,000	\$ 72,000	\$ 84,000	\$ 96,000
Fixed .....	20,000	20,000	20,000	20,000
Semivariable .....	22,000	24,000	27,000	29,000
Total .....	\$102,000	\$116,000	\$131,000	\$145,000
Profit or (loss) .....	\$ (2,000)	\$ 4,000	\$ 9,000	\$ 15,000

planning, cost control, and decision making. A simple illustration of the relationship between costs, volume, and profit appears in Exhibit 1-4. It will be noted that as volume rises, profits increase, but at an increasing rate. This not only emphasizes the importance of operating at a high level of facility utilization but also suggests that it may be possible, under certain circumstances, to decrease prices and, by increasing the number of units sold, raise profits.

### *Cost variability and marginal costs in economics*

In Exhibit 1-5, the data appearing in Exhibit 1-3 has been recast to conform to an economist's version of cost behavior. A comparison between these two exhibits discloses two basic differences:

1. In accounting (Exhibit 1-3), variable costs are regarded as being perfectly variable; i.e., they increase or decrease with changes in output at a *constant rate*. In economics (Exhibit 1-5), increases or decreases in variable costs are viewed as taking place at a *changing rate*. As a consequence, in economics the average variable cost per unit, which is constant in accounting, also changes. In Fig. 1-4, as output rises, average variable cost per unit at first declines, then levels off, and finally rises. The decline in variable cost per unit, which takes place at low activity levels, results from increased efficiency; e.g., labor production per hour rises because of a learning experience. The rise in variable cost per unit takes place at very high levels of operation, when the point of diminishing returns is reached. At this point, bottlenecks occur, too many workers are crowded into the existing space, facilities are used excessively, etc.

*Exhibit 1-5*

#### Cost Behavior in Economics (In total, unit, and marginal costs)

<i>Units produced</i>	<i>Total fixed costs</i>	<i>Total variable costs</i>	<i>Total costs</i>	<i>Average fixed cost per unit</i>	<i>Average variable cost per unit</i>	<i>Average total cost per unit</i>	<i>Marginal costs</i>
1	\$500	\$ 200	\$ 700	\$500	\$200	\$700	\$200
2	500	360	860	250	180	430	160
3	500	510	1,010	167	170	337	150
4	500	650	1,150	125	162	287	140
5	500	780	1,280	100	156	256	130
6	500	925	1,425	83	154	237	145
7	500	1,085	1,585	71	155	226	160
8	500	1,265	1,765	63	158	221	180
9	500	1,495	1,995	56	166	222	230
10	500	1,795	2,295	50	180	230	300



The different treatment of variable costs by accountants does not deny the validity of the economist's concept of cost variability. Since businesses rarely operate at excessively high or low levels, the accountant generally can afford to ignore the possibility of changing rates of cost variability.

2. Unit product costs which emerge from cost accounting systems are average costs. Economic theory, however, is largely concerned with marginal costs. "Marginal cost" represents the increase in total costs resulting from the production of an additional unit, as shown in Exhibit 1-5.

According to economic theory, firm profits are maximized at that point at which marginal revenue, i.e., the increase in total revenue derived from the sale of an additional unit, is equal to marginal cost. A business always will augment short-run profits by making and selling an additional unit, provided marginal revenue exceeds marginal cost.

In Fig. 1-4, average unit cost and marginal cost curves are presented. The marginal cost curve rises sooner and at a higher rate of acceleration than the average variable cost per unit. This occurs because the curve for average variable unit cost is cumulative and is affected by prior data. It will be remembered that from an accounting standpoint, the curve for average total cost per unit never rises (Fig. 1-3). However, according to economic theory, the curve for average total cost per unit slopes upward at very high levels of output, as illustrated in Fig. 1-4. This is

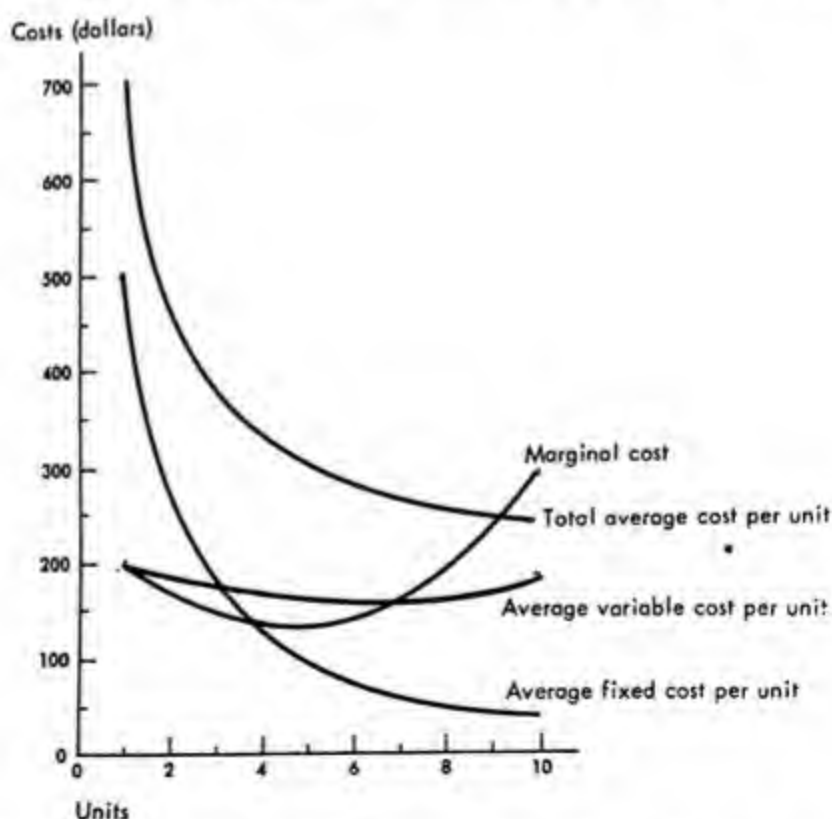


Fig. 1-4 Cost behavior in economics (in terms of unit and marginal costs).

caused by rising marginal costs offsetting the effect of the decline in fixed costs per unit.

The marginal cost concept of the economist has had an influence on the managerial cost accountant. Although accountants normally do not attempt to isolate the cost of a single additional unit, in providing data for managerial decisions they are concerned with added, or *incremental*, costs.

## Alternative costing methods

### Absorption costing or full costing

Under traditional cost accounting, all factory costs are included in the cost of a product for inventory costing purposes, and all nonfactory costs are excluded. This method of costing is referred to as *absorption costing*, or *full costing*. The primary distinction in absorption costing is between product and period costs, i.e., factory and nonfactory costs.

### Direct costing

During recent years, an alternative costing method called *direct costing* has been receiving growing support. Under direct costing only variable factory costs are assigned to products manufactured. The principle cost distinction under direct costing is between fixed and variable costs. According to the underlying rationale of direct costing, variable factory costs are the only costs directly incurred in the manufacture of a product. Fixed costs represent capacity which exists regardless of whether products are manufactured.

### Comparison of absorption costing and direct costing

The amount and presentation of reported income varies under the two costing methods. This may be illustrated by assuming that the Sawbuck Company, which commenced business on January 1, 1963, and manufactured a single product, had the following operating data at the end of the year:

#### Product cost per unit:

Materials	\$10
Direct labor	15
Variable factory overhead	5
Fixed factory overhead	25
Total factory cost per unit	<u>\$55</u>

Production	6,000 units
Sales	5,000 units
Selling price per unit	\$75
Variable selling and administrative expenses	\$17,000
Fixed selling and administrative expenses	\$48,000

*Exhibit 1-6*

**THE SAWBUCK COMPANY**  
Alternative Income Statements  
For the Year Ended December 31, 1963

<i>Under absorption costing:</i>	
Sales (5,000 @ \$75).....	\$375,000
Less: Cost of sales (5,000 @ \$55).....	275,000
Gross profit.....	\$100,000
Less: Selling and administrative expenses.....	65,000
Income.....	<u>\$ 35,000</u>
Closing inventory (1,000 units @ \$55) is \$55,000.	
<i>Under direct costing:</i>	
Sales (5,000 @ \$75).....	\$375,000
Less: Variable costs:	
Factory (5,000 @ \$30).....	\$150,000
Selling and administrative.....	17,000
Total variable costs.....	<u>\$167,000</u>
Contribution to fixed costs and profit.....	\$208,000
Less: Fixed costs:	
Factory (6,000 @ \$25).....	\$150,000
Selling and administrative.....	48,000
Total fixed costs.....	<u>198,000</u>
Income.....	<u>\$ 10,000</u>
Closing inventory (1,000 units @ \$30) is \$30,000.	

In Exhibit 1-6, period income is reported under the two methods. It will be observed that both the form of the income statement and the amount of reported income varies. The difference in income is due to the inclusion or exclusion of fixed factory overhead in the closing (also opening) inventories of finished goods (and work in process).

Under direct costing, variable costs are deducted from sales. Since variable costs are costs which normally would not be incurred if items are not produced, the percentage relationship between variable costs and sales reveals the cash income per dollar of sales to be derived from additional units sold. This represents important information to management in planning and decision making.

There are many ramifications to the controversy regarding the use of absorption or direct costing. They will be discussed at length in Chapter 13.

*Cost control*

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Cost control is an important derivative of cost accounting. Modern business management not only must plan for the future but also must con-



stantly scrutinize the results of operations, so that, wherever possible, out-of-control situations can be attacked and eliminated.

### Characteristics of good cost control

Effective cost control is characterized by the following:

1. Delineation of centers of responsibility. A "cost center" represents a relatively homogeneous activity for which a clear definition of authority exists. Overlapping operations and overlapping responsibilities destroy the very essence of cost control.
2. Delegation of authority. Efforts to achieve cost control are apt to collapse if individuals charged with responsibility are denied the authority to discharge these responsibilities.
3. Cost standards. Cost control presumes the existence of reasonable criteria for measuring performance. These cost standards should be attainable under normal, efficient operating conditions. The individual whose performance is being measured should participate in the setting of the standards.
4. Relevance of controllable costs. Not all costs are controllable, and different costs are controllable at different levels of management. Fluctuations in supply prices may be beyond the discretion of management. A departmental supervisor may exercise little or no influence over the setting of plant labor rates, whereas plant management exercises much wider control over such costs. Only those costs which are controllable directly by an individual are relevant in an evaluation of his performance.
5. Cost reporting. Effective cost control requires timely and meaningful cost reports. These reports should contain a comparison between the standard and actual results.
6. Cost reduction. Cost control reaches its highest level of sophistication when a formal plan exists for eliminating unfavorable deviations from cost standards.

### Cost standards

For control purposes, it is desirable to compare total actual costs incurred during a particular period with any of or all the following:

1. Budgeted total costs
2. Standard total costs
3. Actual total costs of prior periods
4. Actual unit costs of other departments or plants

"Budgeted costs" are estimates of what it is thought the costs *will* be. "Standard costs" are measures of what it is thought the costs *should* be. "Actual costs" depict what the costs *were*.

### Example of a cost report

Different kinds of cost reports may be prepared. A cost report might compare actual and budgeted research or advertising expenditures, or actual versus estimated cost of a special project. A control report might

Exhibit 1-7

A Departmental Cost Report

	This month		This year to date		Last year to date	
	Budget	Actual	Budget	Actual	Budget	Actual
Materials.....	\$ 1,500	\$ 1,380	\$ 3,000	\$ 2,996	\$ 3,000	\$ 3,120
Direct labor.....	5,800	6,100	11,600	12,174	10,400	9,300
Variable overhead:						
Indirect labor.....	2,900	3,070	6,000	7,100	5,700	5,480
Supplies.....	800	1,500	2,200	4,000	1,200	1,100
Repairs.....	2,600	2,550	5,300	3,944	4,800	4,600
Defective goods....	500	800	1,000	1,900	1,000	1,100
	\$14,100	\$15,400	\$29,100	\$32,114	\$26,100	\$24,700

indicate the value, location, and degree of utilization of machinery. Reports on the actual and budgeted costs of materials, direct labor, and the variable portion of factory overhead might be prepared on a daily, weekly, and monthly basis for the use of department heads, foremen, and production managers. Additional information, other than cost data, which might be reported includes the physical quantity of output produced and the number of direct and indirect laborers and the hours worked.

Much information for a control report may be obtained from the cost accounting system. One type of control report appears in Exhibit 1-7. The data presented reflects the activities of a particular department for a specified period of time. When the report indicates that some cost items are out of control, corrective action is taken. The cost reports for two or more departments may be combined to report costs for an entire plant. In a multiplant firm, the cost reports for the various factories for which an executive in charge of production is responsible also may be combined. This reporting of accounting costs by responsibility is often referred to as *responsibility accounting*. The organization structure of each company greatly influences the arrangement of cost accounts and the control reports prepared.

## Costs for decision making

Management decisions involve a selection between alternative courses of action. Costs play a very prominent role in decision making. When quantitative values can be attached to alternatives, management is provided with an indication of the most economically desirable choice. This may not necessarily represent the final decision, since nonquantitative

factors, e.g., prestige, status in the industry, relations with labor, also may influence the decision.

The costs relevant to a particular decision may be accounting costs, modified accounting costs, or costs external to the cost accounting system. Although each decision requires a different array of costs, certain generalizations may be made regarding the relevancy of costs for decision making.

### Future costs

Decisions per se are concerned with the future. While historical costs generally provide a basis for cost prediction, only costs that are expected to be incurred during the anticipated life of a proposal are relevant.

Predicting future costs is fraught with uncertainty, particularly when the cost predictions extend well into the future as in capital-investment decisions. Unfortunately, it is very difficult to establish guidelines for peering into the future. Reference may be made to past cost trends. However, consideration also must be given to the possibility of changing relationships in the future.

### Incremental costs

"Incremental costs" are added costs. They are costs which would not be incurred if a particular project is not undertaken. They are thus *avoidable* costs. Incremental costs also may be regarded as the difference in total costs resulting from a contemplated change. In this sense, incremental costs may be referred to as *differential* costs. Although variable costs generally are incremental, incremental costs also may include fixed costs. For example, a new proposal may involve some expenditures of a fixed nature.

In appraising the desirability of a change, incremental costs may be compared with incremental revenue, i.e., added revenue resulting from the change. The difference may be called *incremental*, *differential*, or *marginal income*. In accounting, the term "marginal income" thus has a

### Exhibit 1-8

#### Illustration of Incremental Income

	<i>Results of present operations</i>	<i>Expected operating results based on a price decrease</i>	<i>Incremental revenue, costs, and income</i>
Sales.....	\$100,000	\$140,000	\$40,000
Less: Variable costs.....	60,000	84,000	24,000
Contribution margin.....	\$ 40,000	\$ 56,000	\$16,000
Less: Fixed costs.....	20,000	20,000	-0-
Income.....	\$ 20,000	\$ 36,000	\$16,000

somewhat different connotation from that in economics, where it refers to the income from the sale of a single additional unit. Exhibit 1-8 illustrates the concept of incremental income.

### Imputed costs

"Imputed costs" are hypothetical costs, at least in the sense that they are alien to, or not recognized by, the accounting system. However, from a decision-making standpoint, imputed costs are hardly theoretical costs.

Interest on capital is a common type of imputed cost. Accounting accords recognition to interest as a cost only if it is actually paid or constitutes a legal liability. In evaluating the desirability of a project, however, failure to give effect to the time value of money, i.e., imputed interest cost, may result in an erroneous decision.

Let us suppose that a company is considering alternative investments, each with a 1-year life and equal risk. Project A requires a capital investment of \$10,000 and project B one of \$8,000. Both projects are expected to earn \$12,000 in incremental income. Obviously, these projects are not equally desirable, since project B requires a smaller investment. If the value of money has been established by the firm, then the cost of the funds tied up in an investment, i.e., interest on capital, can be included directly as a project cost.

### Opportunity costs

An "opportunity cost" is a cost resulting from an alternative which has been forsaken. Assume that a company has space available in a fully depreciated building which it owns. The space can be rented for \$2,000 per annum. The company is considering the utilization of this space in connection with an expansion of one of its product lines. In evaluating the desirability of the project, a charge for space should be included at \$2,000 (opportunity cost) despite the fact that the building is fully depreciated.

### Sunk costs

A "sunk cost" is one for which the expenditure has taken place in the past and which will not be affected by a particular decision under consideration. A sunk cost may be compared with an *out-of-pocket* cost (also incremental cost), which requires an additional outlay of cash.

Suppose that a replacement is being considered for a machine which originally cost \$10,000 and has an accumulated allowance for depreciation of \$5,000. If the machine were scrapped and replaced, an accounting loss of \$5,000 would be sustained. It would seem that this loss should be included as a charge against the replacement under consideration. Actually, apart from tax considerations, the undepreciated book balance of the existing asset is a sunk cost and entirely irrelevant. Only a comparison of the effect on income of the two machines and the return on the additional capital investment are pertinent.



## Summary

Costs provide a basis for measuring income, for profit planning, for control, and for decision making. However, different costs are required for these different objectives. In this regard, the Committee on Cost Concepts and Standards of the American Accounting Association in 1955 stated:

In somewhat comprehensive terms, the purposeful aspect of cost means that because managerial objectives vary both in scope of activity (ranging from over-all activities to a multitude of minor activities) and in the nature of the management function being performed (ranging from planning to control), the value releases to be included in any cost report will vary with the situation of the firm as well as the specific objectives of management. In a broad sense, this recognizes that the cost of anything will depend upon the purpose for determining cost.

## Problems and cases

- 1-1 *Accounting income.* What is accounting income? What is the relationship between accounting income and cost accounting? Can income be determined in the absence of cost accounting? What limitations are there to this procedure?
- 1-2 *Monetary fluctuations.* Does the changing value of the dollar have significance to the cost accountant?
- 1-3 *Economists' and accountants' views of costs.* How does an accountant's view of costs differ from that of an economist? Under what circumstances should the costs used for financial accounting purposes be modified?
- 1-4 *Marginal income.* What is meant by marginal income analysis? What influence has this had on cost accounting?
- 1-5 *Product costing.* How does a cost accountant compute the cost of a product manufactured? What are some of the difficulties encountered?
- 1-6 *Cost variability.* Distinguish among variable, fixed, and semivariable costs. Why is this distinction important?
- 1-7 *Cost variability.* Indicate which of the following costs normally would be fixed, variable, and semivariable. Can you think of any circumstances when any of these costs might be in a category different from the one specified by you?

Raw materials used	Repairs
Depreciation	Direct labor
Supervision	Taxes
Supplies	Machinery



- 1-8 *Cost control.* You are informed that a plant is losing money because of inadequate cost control and are requested to institute an effective system of cost control. What general principles would guide you?
- 1-9 *Period costs.* What kinds of cost are treated as period costs or expenses by accountants? What reasons exist for this treatment? Can this result in distortions in income?
- 1-10 *Absorption and direct costing methods.* What causes the difference in income under absorption and direct costing?
- 1-11 *Responsibility accounting.* What is meant by responsibility accounting? What are its prerequisites?
- 1-12 *Costs, expenses, and losses.* Distinguish among costs, expenses, and losses. Give an example of each.
- 1-13 *Objectives of cost accounting.* What are the three principal objectives of cost accounting? Can the same cost data be used to accomplish these purposes?
- 1-14 *Fixed costs.* What are the three categories of fixed costs? Give an example of each type of fixed cost.
- 1-15 *Cost terminology.* Give an example for each category listed:
1. A fixed direct departmental cost \_\_\_\_\_
  2. A cost allocated to a producing department \_\_\_\_\_
  3. An indirect material \_\_\_\_\_
  4. A direct material \_\_\_\_\_
  5. A loss \_\_\_\_\_
  6. A variable period cost \_\_\_\_\_
  7. A semivariable cost \_\_\_\_\_
  8. A fixed period cost \_\_\_\_\_
  9. A cost which is direct to a producing department but indirect to products or jobs \_\_\_\_\_
  10. An indirect labor cost which is a direct department cost \_\_\_\_\_
  11. An imputed cost \_\_\_\_\_
  12. Prime cost \_\_\_\_\_
  13. An indirect labor cost which is indirect to a producing department \_\_\_\_\_
  14. An opportunity cost \_\_\_\_\_
  15. A sunk cost \_\_\_\_\_
- 1-16 *Cost terminology.* Insert in column 1 the number of the description in column 2 which best matches the item in column 1.

## Column 1

- Total variable costs \_\_\_\_\_
- Unit variable cost (as viewed by accountants) \_\_\_\_\_
- Unit variable cost (as viewed by economists) \_\_\_\_\_
- Actual costs \_\_\_\_\_

## Column 2

1. Point at which variable cost per unit rises
2. Remains constant per unit
3. Costs not assigned to products
4. Increases in total proportional to output

## Column 1 (continued)

Total fixed costs	_____
Budgeted cost	_____
Fixed cost per unit	_____
Marginal cost (in economics)	_____
Overhead rate	_____
Standard costs	_____
Labor and overhead	_____
Incremental cost	_____
Intersection of marginal cost and marginal revenue	_____
Period costs	_____
Point of diminishing return	_____

## Column 2 (continued)

5. Decreases with rises in output but at a declining rate
6. Point of profit maximization
7. Used to apply factory overhead to products or jobs
8. What costs are expected to be
9. At first declines, levels off, and then rises, as output increases
10. Incurred costs
11. Remains constant in total
12. Cost of conversion
13. Added cost of a new project
14. Cost of an added unit
15. What costs should be

1-17

**Cost terminology. Instructions:** You are to match each of the nine numbered items with the one term listed below (A through P) which most specifically identifies the cost concept indicated parenthetically.

**Caution:** An item of cost may be classified in several ways, depending on the purpose of the classification. For example, the commissions on sales of a proposed new product line might be classified as direct, variable, and marginal, among other categories. However, if such costs are being considered specifically as to the amount of cash outlay required in making a decision concerning adoption of the new line, the commissions are out-of-pocket costs. That would be the answer most appropriate to the context.

On your answer sheet list the numbers 1 through 9. Indicate your choice of answer for each item by printing beside the item numbers the capital letter which identifies the term you select.

## Term

- A. Controllable costs
- B. Direct costs
- C. Estimated costs
- D. Fixed costs
- E. Historical cost
- F. Imputed costs
- G. Differential cost
- H. Indirect costs

## Term

- I. Opportunity costs
- J. Original cost
- K. Out-of-pocket costs
- L. Prime costs
- M. Replacement costs
- N. Standard costs
- O. Sunk costs
- P. Variable costs

## Items:

1. The management of a corporation is considering replacing a machine which is operating satisfactorily with a more efficient new model. Depreciation on the cost of the existing machine is omitted from the data used in judging the proposal, because it has little or no significance with respect to such decision. (The omitted cost.)
2. In public utility accounting, regulatory bodies require that assets be

- carried at the cost to those owners who first devoted the assets to public use. (The cost described.)
- One of the problems encountered by a bank in attempting to establish the cost of a commercial-deposit account is the fact that many facilities and services are shared by many revenue-producing activities. (Costs of the shared facilities and services.)
  - A company declined an offer received to rent one of its warehouses and elected to use the warehouse for storage of extra raw materials to ensure uninterrupted production. Storage cost has been charged with the monthly amount of the rental offered. (This cost is known as?)
  - A manufacturing company excludes all "fixed" costs from its valuation of inventories, assigning to inventory only applicable portions of costs which vary with changes in volume of product. (The term employed for the variable costs in this context by advocates of this costing procedure.)
  - The sales department urges an increase in production of a product and, as part of the data presented in support of its proposal, indicates the total additional cost involved for the volume level it proposes. (The increase in total cost.)
  - A firm includes in the cost of a fixed asset an "interest" charge based on the firm's own funds invested in the asset. The firm states that the charge was intended to obtain a cost comparable with the cost if funds had been borrowed to finance the acquisition. (The term which describes such interest charges.)
  - The "direct" production cost of a unit includes those portions of factory overhead, labor, and materials which are obviously traceable directly to the unit. (The term used to specify the last two of the components named.)
  - Calling upon the special facilities of the production, planning, personnel, and other departments, a firm estimated its future unit cost of production and used this cost (analyzed by cost elements) in its accounts. (The term used to specify this predetermined cost.)

(AICPA adapted)

1-18 *Marginal analysis*

<i>Units</i>	<i>Total revenue</i>	<i>Total fixed costs</i>	<i>Total variable costs</i>	<i>Total costs</i>	<i>Average cost per unit</i>	<i>Mar- ginal revenue</i>	<i>Mar- ginal cost</i>	<i>Mar- ginal income</i>
0	-0-	\$10,000	-0-					
1	\$10,000	10,000	\$ 6,000					
2	19,400	10,000	11,500					
3	28,000	10,000	16,700					
4	36,000	10,000	21,700					
5	43,000	10,000	26,700					
6	48,000	10,000	31,900					
7	52,000	10,000	37,400					

*Required:*

- Complete the foregoing schedule.
- At approximately what level of sales is the break-even point?

3. At what point is it uneconomical to produce and sell an additional unit?
4. What assumptions are implicit in this schedule that are not generally adhered to in accounting practice?

1-19

*Effect of production levels on costs.* The Fertile Farm Company manufactures a single product called Agro. During a particular period the following costs were incurred:

Variable:	
Raw materials.....	\$3.00 per bag
Direct labor.....	\$2.00 per bag
Factory supplies.....	\$ .40 per bag
Delivery expenses.....	\$ .15 per bag
Salesmen's commissions.....	\$ .75 per bag
Fixed:	
Depreciation—plant and machinery.....	\$8,000
Plant supervision.....	\$5,000
Plant manager.....	\$10,000
Plant taxes and insurance.....	\$2,000
Selling and administrative expenses.....	\$8,000

No inventories were on hand at the beginning of the period, but 1,000 bags of Agro were on hand at the close of the period. The selling price of Agro is \$9.50 per bag.

*Required:*

1. What would the company's income and ending inventory be if:
  - a. 10,000 units had been produced?
  - b. 12,000 units had been produced?
  - c. 14,000 units had been produced?
2. a. Why do the total unit factory costs in (1a), (1b), and (1c) vary?  
 b. Do you agree that the inventory cost should properly be higher in (1a) than in (1b) and (1c)?  
 c. If you do not agree, can you suggest a way for avoiding this condition?

1-20 *Cost variability and management decisions.* A company's annual income statement was as follows:

Sales (10,000 units @ \$10).....	\$100,000
Costs:	
Materials used.....	\$ 30,000
Direct labor.....	20,000
Depreciation—plant and machinery.....	8,000
Factory supplies.....	4,000
Supervision.....	5,000
Plant manager.....	10,000
Taxes and insurance.....	2,000
Depreciation—delivery equipment.....	2,000
Gas, oil, and repairs of delivery equipment.....	1,500
Salesmen's commissions.....	7,500
Total costs.....	\$ 90,000
Profit.....	\$ 10,000

Materials used, direct labor, factory supplies, and gas, oil, and repairs of delivery equipment vary with the number of units sold. Selling commissions vary with total sales. You are advised that if the price is reduced 10 percent 12,000 units can be sold. No additional facilities are required. Should the price be reduced?

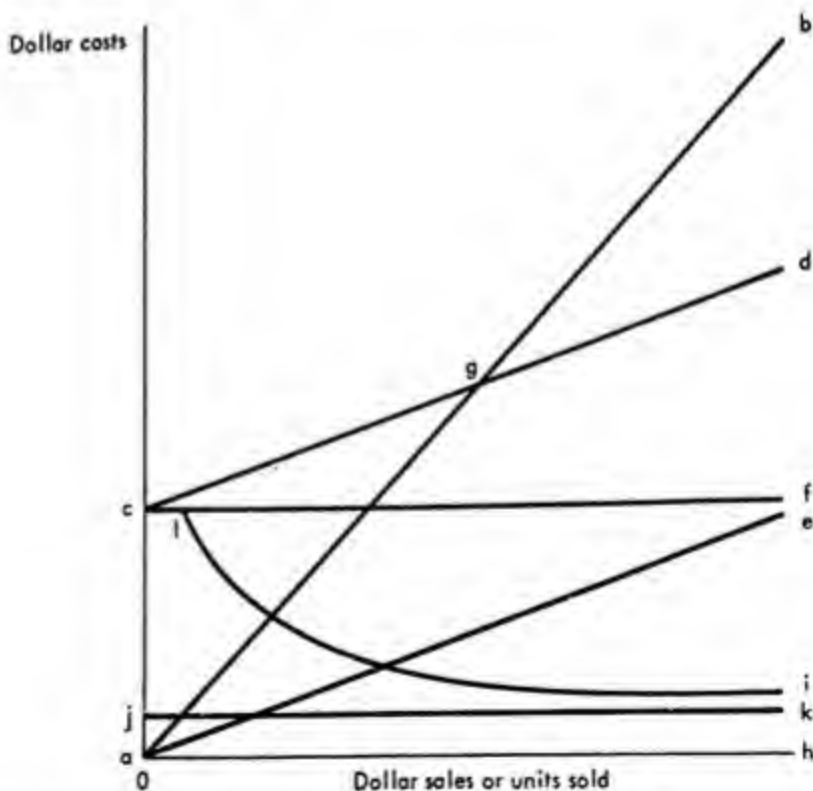
- 1-21** *Relevant costs in decision making.* Al Clark lives in a small town about 35 miles from New York City, where he works. He commutes to work 5 days a week at a monthly cost of \$42 (railroad \$36, subways \$6).

One of Clark's neighbors, who also commutes to New York City, has offered to contribute \$35 a month if Clark will drive to work using his car. Clark at present uses his car only on weekends. He estimates the monthly cost of driving to work as follows:

Depreciation of car (portion applicable to commutation use)	\$30
Bridge tolls	10
Parking	15
Gas and oil	32
Tires and miscellaneous expenses	12
Total	<u>\$99</u>

Should Clark accept the offer?

- 1-22** *Cost behavior.* In the graph, line *ab* represents the sales of the Oxford Company; all other lines are cost lines.



*Required:*

1. Line *cd* is \_\_\_\_\_.
2. Line *ef* is \_\_\_\_\_.



3. Line *ae* is \_\_\_\_\_.
4. Line *jk* is \_\_\_\_\_.
5. Curve *li* is \_\_\_\_\_.
6. Area *aei* is \_\_\_\_\_.
7. Area *acde* is \_\_\_\_\_.
8. Area *acg* is \_\_\_\_\_.
9. Area *bgd* is \_\_\_\_\_.
10. Point *g* is \_\_\_\_\_.
11. Draw a dotted line *mn* which would indicate what happens if fixed costs are increased. Label the point at which line *mn* crosses line *ab* as point *O*.
12. Point *O* is the new \_\_\_\_\_.
13. What is the significance of point *O* in relation to point *g*?

- 1-23** *Total unit product cost and income determination.* The Arcadia Manufacturing Company has a single process. Operating data for the months of January and February were as shown below. All units manufactured during a month were sold at \$10 each.

	Jan.	Feb.
Total processing costs.....	\$13,200	\$13,200
Units completed.....	2,000	2,000
Units in process beginning of month.....	—0—	—0—
Units in process end of month ( $\frac{1}{2}$ finished).....	—0—	400
Selling and administrative expenses.....	\$4,500	\$4,500

The following income statements were prepared by the accounting department:

	Jan.	Feb.
Sales (2,000 @ \$10).....	\$20,000	\$20,000
Cost of sales (2,000 @ \$6.60).....	13,200	13,200
Gross profit.....	\$ 6,800	\$ 6,800
Less: Selling and administrative expenses...	4,500	4,500
Income.....	<u>\$ 2,300</u>	<u>\$ 2,300</u>

*Required:* Do you agree with the data shown in the income statements? If not, what changes would you make?

- 1-24** *Cost-volume-profit relationships.* The Fan Tan Company is considering the introduction of a new product. It is estimated that the new product will require \$36,000 of fixed costs and that variable costs will amount to \$1.65 per unit. The sales department estimates that, if the product is sold at \$2, sales will fall within the range of 80,000 to 120,000 units.

*Required:*

1. What would be the profit if 80,000 units were sold? 100,000? 120,000?
2. Develop an algebraic formula which will permit you to determine the break-even point for the new product.

- 1-25** *Cost control.* The Smooth Flow Pen Company manufactures several different types of mechanical pens and pencils, ranging in price from \$1.50 to \$10 each. At the close of the quarter ended March 31, 1964, the plant manager received the following report from the accounting department.

**SMOOTH FLOW PEN COMPANY**  
**Cost Report—Plastics Department**  
**Quarter Ended March 31, 1964**

	<i>Jan.</i>	<i>Feb.</i>	<i>Mar.</i>
Materials used.....	\$37,000	\$50,200	\$ 66,700
Direct labor.....	11,000	12,100	18,300
Supplies.....	5,200	6,600	9,000
Supervision.....	2,200	2,200	2,200
Repairs.....	4,500	6,200	2,400
Depreciation—machinery.....	1,800	1,800	1,800
Power.....	900	1,000	1,100
Building costs (allocated on basis of space occupied).....	2,700	2,700	2,700
Charges from service departments.....	3,600	3,500	3,800
<b>Total.....</b>	<b>\$68,900</b>	<b>\$86,300</b>	<b>\$108,000</b>
Units produced.....	220,000	280,000	360,000
Cost per unit.....	\$ .313	\$ .308	\$ .300

After receiving departmental cost reports, the plant manager customarily holds a meeting with department managers to review the results of operations reported. The plant controller also attends these sessions.

*Required:* If you were the plant manager, based on the report submitted for the plastics department, what comments would you make at the meeting?

## 2. The Cost Accounting Cycle

Determining the cost of jobs and products manufactured, for purposes of income measurement and balance sheet presentation of inventories, is one of the principal objectives of cost accounting. In this chapter, the cost accounting procedures applicable to the accumulation of factory costs and their assignment to goods manufactured will be described in general terms. More extensive discussions of cost accounting procedures and their ramifications take place in subsequent chapters.

### Factory cost flow and cost accounts

A factory usually is divided into organizational areas known as *departments, processes, or cost centers*. Manufacturing costs which are incurred in the factory are *attached, or assigned*, to production as it flows through the factory departments; conceptually, then, costs also flow. The flow of factory costs follows the physical movement of raw materials as they are received, stored, disbursed, and converted into finished goods. This is illustrated in Fig. 2-1.

In a broad sense, the manufacturing cycle can be separated into three major phases: (1) raw materials storage, (2) processing of raw materials into finished goods, and (3) finished goods storage, although in many companies the control of finished goods comes under the jurisdiction of the sales department and technically should not be considered part of the manufacturing cycle. The nature of inventories differs at each of these phases in the cycle. Accordingly, three general types of inventory accounts are employed in cost accounting: raw materials, work in process, and finished goods.

Charges to Work in Process consist of the three elements of manufacturing cost: raw materials used, direct labor, and factory overhead. The cost of raw materials used and direct labor incurred normally are charged directly to the Work in Process account. Factory-overhead costs, however, are first accumulated in a separate ledger account called Factory Overhead and then assigned or applied to Work in Process.

There are two reasons for not charging factory overhead directly to the Work in Process account. First, there are several different kinds of factory-overhead costs, and better cost control is provided through the establishment of a separate control account supported by a subsidiary

## THE COST ACCOUNTING CYCLE

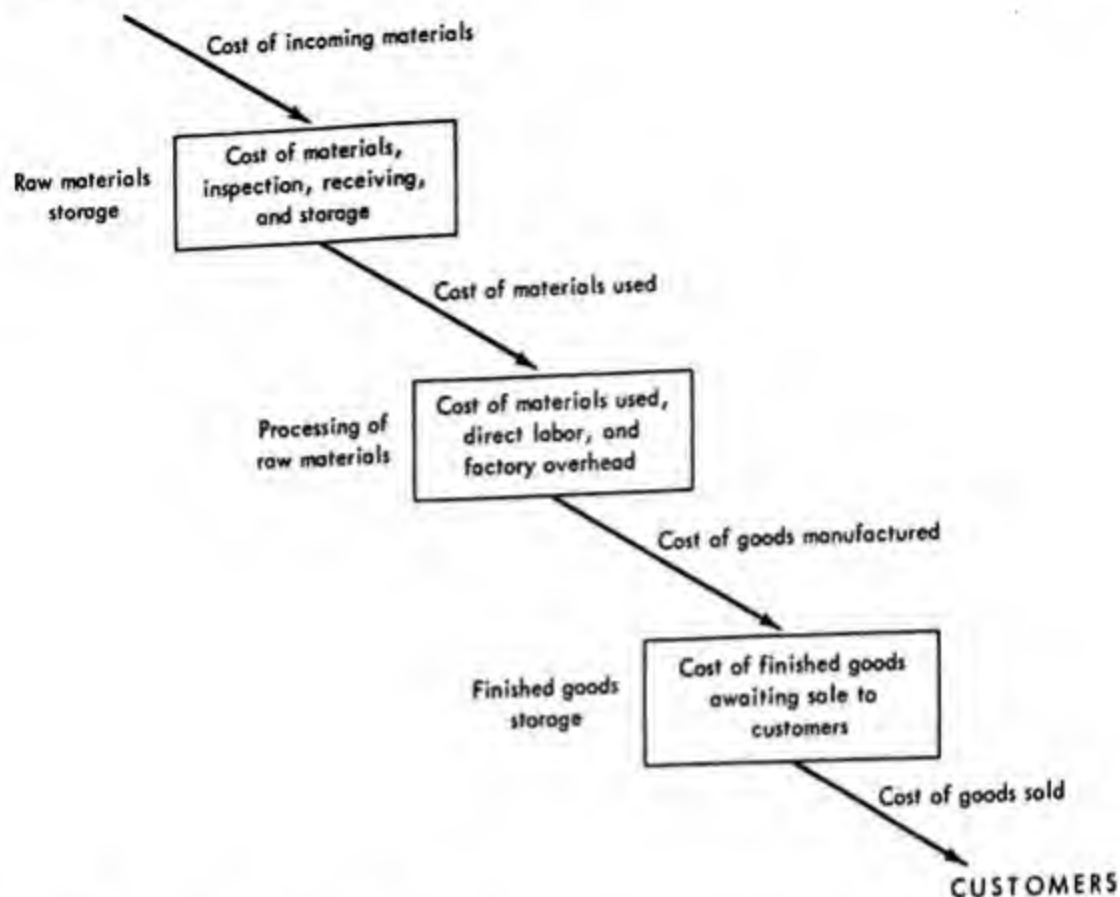


Fig. 2-1 The flow of factory costs.

ledger which contains the details for each cost item. Second, factory overhead cannot readily be identified with jobs or products manufactured, as is the case with raw materials and direct labor. The assignment or application of factory costs to Work in Process thus requires special treatment, which will be discussed in a subsequent chapter.

### Operating statements for a manufacturing concern

The flow of factory costs shown in Fig. 2-1 results in statements of income, cost of sales, and cost of goods manufactured, as presented in Exhibits 2-1 to 2-3 for the Thompson Company.

#### Exhibit 2-1

#### THE THOMPSON COMPANY Statement of Income For the Month Ended January 31, 1964

Sales.....	\$100,000
Less: Cost of sales [Exhibit 2-2].....	65,000
Gross profit.....	\$ 35,000
Less: Selling and administrative expenses.....	25,000
Income.....	<u>\$ 10,000</u>

**Exhibit 2-2**

**THE THOMPSON COMPANY**  
**Statement of Cost of Sales**  
**For the Month Ended January 31, 1964**

Finished goods inventory, Jan. 1, 1964.....	\$15,000
Cost of goods manufactured [Exhibit 2-3].....	70,000
Cost of goods available for sale.....	<u>\$85,000</u>
Less: Finished goods inventory, Jan. 31, 1964....	20,000
Cost of goods sold.....	<u><u>\$65,000</u></u>

**Exhibit 2-3**

**THE THOMPSON COMPANY**  
**Statement of Cost of Goods Manufactured**  
**For the Month Ended January 31, 1964**

Raw materials inventory, Jan. 1, 1964.....	\$30,000
Purchases.....	60,000
Materials available for use.....	<u>\$90,000</u>
Less: Raw materials inventory, Jan. 31, 1964.....	60,000
Raw materials used.....	<u>\$30,000</u>
Direct labor.....	20,000
Factory overhead.....	<u>25,000</u>
Total manufacturing costs.....	<u>\$75,000</u>
Add: Work in process, Jan. 1, 1964.....	12,000
Total.....	<u>\$87,000</u>
Less: Work in process, Jan. 31, 1964.....	17,000
Cost of goods manufactured.....	<u><u>\$70,000</u></u>

These statements may be prepared for a manufacturing concern even in the absence of cost accounting. This can be accomplished by taking physical inventories of raw materials, work in process, and finished goods at the beginning and end of the period. However, as was indicated in the previous chapter, there are serious limitations to this procedure. Cost accounting provides a routine method for tracing the flow of costs through the accounts and determining income without the necessity of having to take physical inventories.

### *Accounting for raw materials*

#### **Raw materials flow and accounts**

The flow of raw materials and the accounts which depict this flow are presented in Fig. 2-2.



## THE COST ACCOUNTING CYCLE

## Flow of raw materials

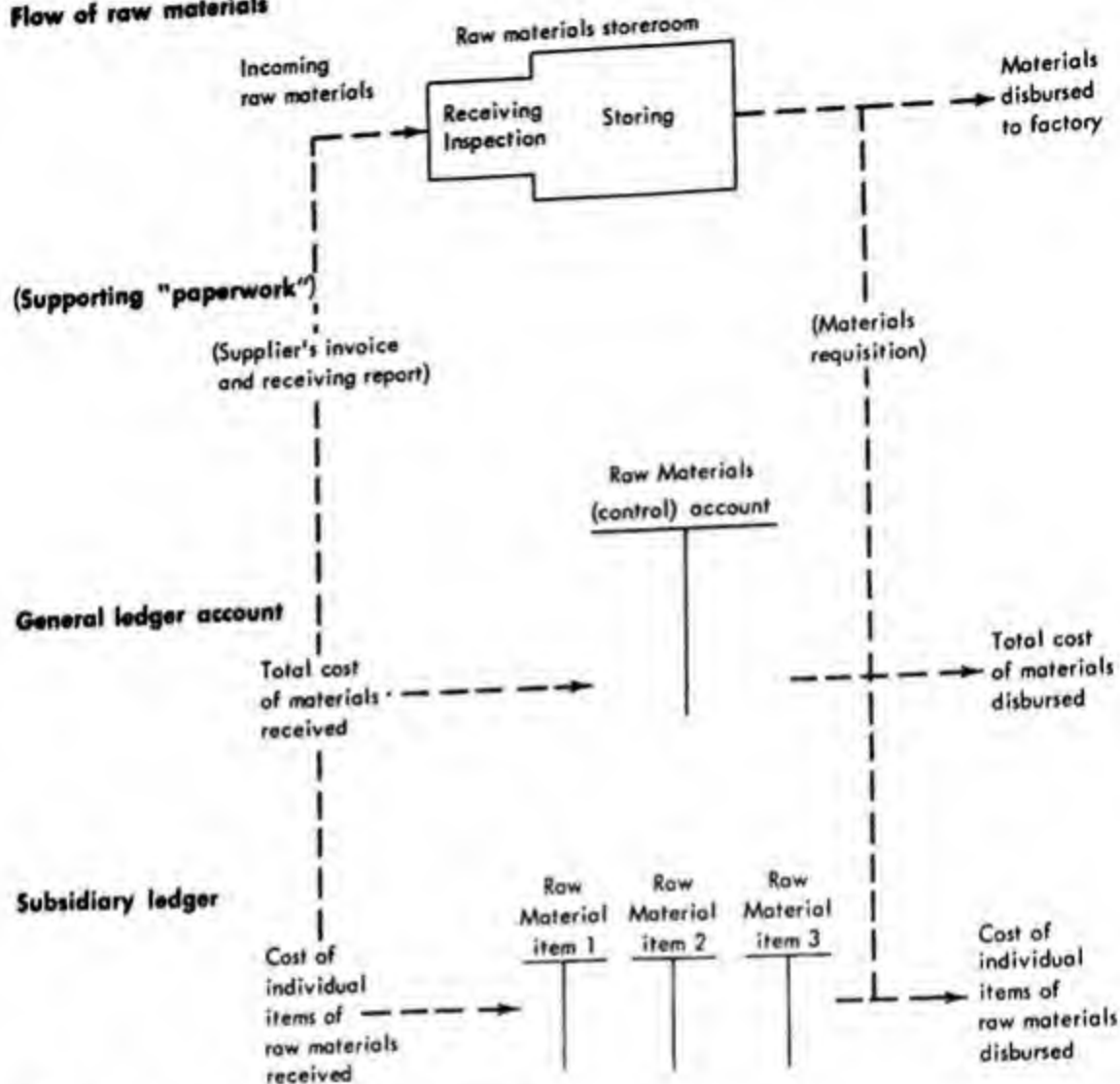


Fig. 2-2 Raw materials flow and accounts.

A *receiving report*, which indicates the types and quantities of materials received from each supplier, is prepared at the time materials are received. One copy of the receiving report is sent to the accounting department, where it is matched with the supplier's invoice, which contains the quantities and prices of each item of raw materials shipped. These two documents provide authorization for recording the liability and making payment to the supplier. The supplier's invoice also is the basis for charging the Raw Materials account with the cost of materials received.

After raw materials have been received and inspected, they are sent to stores, or storerooms, until required for production. In many companies, in addition to raw materials, all or selected supplies also may be maintained and controlled by the storekeeper. In such situations, the in-

ventory account often is called *Stores or Materials and Supplies* rather than *Raw Materials*.

In addition to the net invoice price of raw materials, related costs such as freight, receiving, inspection, and storing may properly be added to the cost of raw materials. However, certain difficulties are encountered in attaching such costs to materials. These and other complexities of raw materials accounting will be explored in Chapter 3.

As raw materials are needed for production, they are released from stores on the basis of a *materials requisition* form. The materials requisition is prepared in the factory and authorizes stores to forward specified quantities of raw materials at the time stipulated. The materials requisition is the basis for crediting *Raw Materials* and charging *Work in Process* for materials disbursed. From a control standpoint, this document also relieves the storekeeper of accountability for the materials.

### Perpetual and book inventories

In a manufacturing firm, records generally are maintained at the store-room or other locations which indicate for each item of raw material the quantities on hand at the beginning of the period, receipts, disbursements, and the balance at the close of the period. These records are called *perpetual inventories*. In addition to quantities, perpetual-inventory records may include the costs of raw material items. If so, they often are referred to as *book inventories*. Book inventories constitute a subsidiary ledger, since the aggregate costs of the individual raw material items equal the balance appearing in the *Raw Materials Control* account on the general ledger.

Perpetual inventory records are an important control device. They provide information which permits the purchasing department to place orders in a manner designed to minimize the inventory investment and yet avoid the loss of potential discounts and production bottlenecks due to material shortages. They also contain data which are useful in production planning and scheduling. When a perpetual inventory system exists, physical counts of selected raw materials may be made throughout the year on a rotating basis. If significant discrepancies are revealed between the physical count and the perpetual inventory records, the paperwork supporting the perpetual inventory records may be checked for possible errors or some other explanation sought, e.g., theft.

### Journal entries for raw materials

The journal entries required to record the flow of raw materials may be illustrated by assuming the following facts for ABCO Inc.:

(1) Beginning balance in Raw Materials account.....	\$44,000
Consisting of:	
Item 1.....	5,000 units @ \$2.00
Item 2.....	8,000 units @ \$1.50
Item 3.....	4,000 units @ \$5.50

- (2) Purchases:
- |             |                       |
|-------------|-----------------------|
| Item 1..... | 12,000 units @ \$2.00 |
| Item 3..... | 6,000 units @ \$5.50  |
- (3) Disbursed to factory:
- |             |             |
|-------------|-------------|
| Item 1..... | 3,500 units |
| Item 2..... | 2,000 units |
| Item 3..... | 3,000 units |
- (4) Defective materials returned to suppliers:
- |             |           |
|-------------|-----------|
| Item 1..... | 200 units |
|-------------|-----------|
- (5) Excess materials returned to stores by factory:
- |             |          |
|-------------|----------|
| Item 2..... | 50 units |
|-------------|----------|

The journal entries to record these transactions are as follows:

(2)

Raw Materials.....	57,000	
Vouchers Payable.....		57,000

(To record receipt of 12,000 units of item 1 @ \$2 and 6,000 units of item 3 @ \$5.50)

(3)

Work in Process.....	26,500	
Raw Materials.....		26,500

(To record issuance to factory of 3,500 units of item 1, 2,000 units of item 2, and 3,000 units of item 3)

(4)

Vouchers Payable.....	400	
Raw Materials.....		400

(To record return of 200 defective units of item 1 to supplier)

(5)

Raw Materials.....	75	
Work in Process.....		75

(To record return to storeroom of 50 excess units of item 2)

Using T accounts, which are condensed reproductions of actual ledger accounts, after these entries have been recorded, the Raw Materials account and the subsidiary material accounts would appear as shown below:

**General Ledger:**

Raw Materials	
(1) 44,000	(3) 26,500
(2) 57,000	(4) 400
(5) 75	Bal. 74,175
<u>101,075</u>	<u>101,075</u>
Bal. 74,175	

*Subsidiary Ledger:*

Raw Materials Item 1		Raw Materials Item 2		Raw Materials Item 3	
(1) 10,000	(3) 7,000	(1) 12,000	(3) 3,000	(1) 22,000	(3) 16,500
(2) 24,000	(4) 400	(5) 75	Bal. 9,075	(2) 33,000	Bal. 38,500
	Bal. 26,600				
<u>34,000</u>	<u>34,000</u>	<u>12,075</u>	<u>12,075</u>	<u>55,000</u>	<u>55,000</u>
Bal. 26,600		Bal. 9,075		Bal. 38,500	

*Accounting for goods manufactured and sold***Job-order and process cost accounting systems**

In order to calculate the cost of units produced, it is necessary to have a system for collecting costs and assigning them to products or jobs manufactured. In general, two types of cost accounting systems may be employed, depending on the nature of the manufacturing activities: *process cost systems* and *job-order cost systems*. A combination of the features of both systems might exist within a single company or plant. These two cost systems are discussed at length in later chapters. However, in order to understand the mechanics of the cost accounting cycle, some general comments regarding the nature of the two systems are necessary.

The essential difference between a process and job-order cost system is one of primary emphasis in the assigning of costs. Under a job-order system, the goods being produced are divided into batches and called *jobs*, or *lots*. A *job cost sheet* is kept for each batch of production, and each job cost sheet is numbered or otherwise identified. The three elements of production cost are then specifically and directly assigned to these jobs, day by day, as they are processed. Job cost sheets serve as the subsidiary ledger for work in process. The primary emphasis is upon assigning costs to batches of products or jobs. The time period or department in which the costs are incurred is of secondary importance in the accumulation of costs. A job-order arrangement is often necessary when goods are produced according to the individual specifications of customers. This type of operation is known as a *job shop*.

Exhibit 2-4 contains a report of the status of jobs for the Sawyer Company at the end of its first month of operations. It will be noted that during the month total actual factory overhead amounted to \$14,000, which was 200 percent of the total direct-labor costs. This *actual-overhead rate* was applied to each job worked on during the month. Other possibilities for applying overhead to jobs are discussed in a later chapter. At the end of the month, the cost of jobs completed and shipped to customers amounted to \$8,300. This will appear as the cost of sales on the company's income statement for the month. The \$20,100 of jobs still

## Exhibit 2-4

**THE SAWYER COMPANY**  
Status of Jobs as of January 31, 1964

<i>Job no.</i>	<i>Materials</i>	<i>Labor</i>	<i>Overhead</i>	<i>Cost of jobs still in process, Jan. 31</i>	<i>Cost of jobs completed in January</i>
101	\$ 500	\$1,100	\$ 2,200		\$3,800
102	1,300	600	1,200		3,100
103	900	1,000	2,000	\$ 3,900	
104	200	400	800		1,400
105	2,600	1,800	3,600	8,000	
106	1,900	2,100	4,200	8,200	
Total.....	\$7,400	\$7,000	\$14,000	\$20,100	\$8,300

in process on January 31 will be shown on the balance sheet as work in process.

A process cost system is used when essentially standardized products are manufactured on a rather continuous basis. The primary emphasis under a process cost system is upon assignment of the elements of manufacturing cost to a *department, cost center, or process for a period of time* such as a day, a week, or a month. *Department cost sheets*, on which unit and total cost of goods completed and transferred to succeeding departments and goods still in process are shown, serve as the subsidiary ledger for work in process. Unit costs of the output of a department can be calculated at the end of the time period when both costs incurred and quantities produced are known.

In a process cost system, the product normally passes through a series of successive operations. In each process, the cost of goods completed is calculated by dividing total process costs by the number of units completed. The unit and total cost of goods completed is then transferred to the next process. When more than one product is processed, the total process costs must be allocated among these products.

An example of a process cost report is presented in Exhibit 2-5. In Process 3, it will be noted, 50,000 additional units of materials have been added at a cost of \$80,000. Since the 50,000 units transferred from Process 2 at a total cost of \$220,000 will now yield an output of 100,000 units, the transferred unit cost declines from \$4.40 to \$2.20. The final output of Process 3 is transferred to finished goods at a unit cost of \$3.80.

Let us suppose that in Process 1, instead of 50,000 units completed, only 40,000 are finished and 10,000 are still in process, 50 percent completed. These 10,000 units which are 50 percent completed are equivalent to 5,000 fully completed units. The production of Process 1 therefore



Exhibit 2-5

## Process Cost Report

	Process 1		Process 2		Process 3	
	Total cost	Unit cost	Total cost	Unit cost	Total cost	Unit cost
Costs to be accounted for:						
From prior department . . .	-0-	-0-	\$100,000	\$2.00	\$220,000	\$2.20
Departmental costs:						
Raw materials . . . . .	\$ 40,000	\$ .80	-0-	-0-	80,000	.80
Direct labor . . . . .	25,000	.50	40,000	.80	40,000	.40
Factory overhead . . . . .	35,000	.70	80,000	1.60	40,000	.40
Total . . . . .	\$100,000	\$2.00	\$220,000	\$4.40	\$380,000	\$3.80
Costs accounted for:						
Completed and transferred	\$100,000	\$2.00	\$220,000	\$4.40	\$380,000	\$3.80
Units to be accounted for:						
From prior department . . .	-0-		50,000		50,000	
New units added . . . . .	50,000		-0-		50,000	
Total . . . . .	50,000		50,000		100,000	
Units accounted for:						
Completed and transferred	50,000		50,000		100,000	

would be 45,000 units ( $40,000 + 5,000$ ) and the unit cost \$2.222 ( $\$100,000/45,000$ ). The \$100,000 of total costs incurred in Process 1 now would be accounted for as follows:

Completed and transferred ( $40,000 @ \$2.222$ ) . . . . .	\$ 88,889
In process (10,000 one-half completed, or 5,000 @ \$2.222) . . . . .	11,111
Total costs accounted for . . . . .	\$100,000

## Manufacturing flow and accounts

Figure 2-3 traces the production flow, accompanying paperwork, and the relevant cost accounts for a manufacturing concern.

Materials requisitions provide the basis for charging the Work in Process (Control) account and the subsidiary departmental or job-order cost sheets with the cost of materials used. The entry recorded in the general ledger to reflect this flow of materials is as follows:

Work in Process . . . . .	XXX
Raw Materials . . . . .	XXX

The total amount of direct labor and its distribution between departments and jobs is obtained from clock cards and time tickets. The *clock card* discloses the number of hours worked by each laborer. The number

## THE COST ACCOUNTING CYCLE

## Production flow

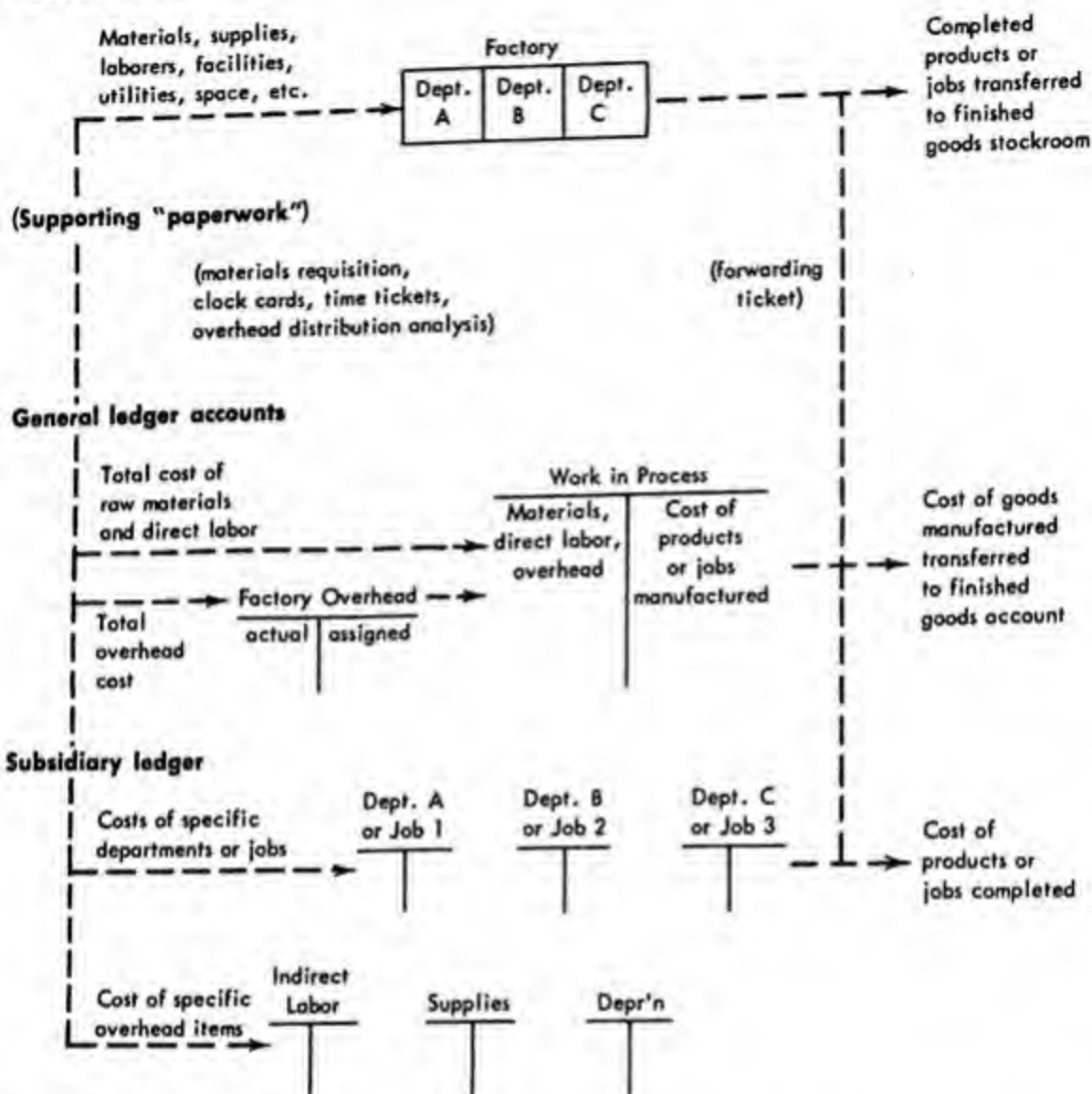


Fig. 2-3 Production flow and accounts.

of elapsed hours shown on the clock card multiplied by the hourly rate results in the gross amount of direct-labor (or indirect-labor) cost for an employee. *Time tickets* indicate the manner in which the elapsed time of each worker was distributed during the course of each day. The journal entry to record the cost of direct and indirect labor might be as follows:

Work in Process (Direct).....	XXX	
Factory Overhead (Indirect).....	XXX	
Payroll Accrued.....		XXX

An *overhead distribution analysis* is a form used to allocate total factory overhead to different departments and for establishing a basis, i.e.,

a rate, for charging overhead to the various jobs worked on. The entry for the incurrence of factory overhead is as follows:

Factory Overhead (Control).....	XXX	
Allowance for Depreciation.....		XXX
Vouchers Payable.....		XXX
Accrued Expenses and Various Other		
Accounts.....		XXX

The entry, based on the overhead distribution analysis, for charging factory overhead to Work in Process is as follows:

Work in Process.....	XXX	
Factory Overhead.....		XXX

In Fig. 2-3, a single Work in Process and a single Factory Overhead account appears. Variations may occur in practice. Factory-overhead and work-in-process accounts may be maintained for each department or element of cost, e.g., Work in Process—Process 1, Work in Process—Materials.

The Factory Overhead account (or accounts) on the general ledger generally is supported by a subsidiary ledger which indicates the amount of each type of expense. The Work in Process account (or accounts) also is supported by subsidiary job-order or departmental cost sheets. When a job has been completed, the job sheet is totaled and closed out. The total amount shown on the job sheet is used to relieve the Work in Process account and charge the Finished Goods account for the cost of work completed. In a process cost system, the subsidiary departmental cost sheets indicate the cost of products completed and transferred to succeeding departments. *Forwarding tickets* are used to transfer the cost of completed goods from one department to another or to the finished goods stockroom. The journal entry to record this transfer of costs is as follows:

Finished Goods.....	XXX	
Work in Process.....		XXX

### Cost of goods sold

As finished goods are sold and delivered to customers, the accountability for the goods (which have now been marked up from manufacturing cost to selling price) is transferred from the finished goods storage function to the accounts receivable and collection functions. The *sales invoice* together with a *shipping ticket* are the documents which evidence this transfer of accountability and also provide the basis for the recording of revenues and receivables. The sales invoice and shipping ticket also provide documentation for relieving the Finished Goods account of the manufactured cost of goods sold and charging this to the Cost of Goods Sold account. The journal entries to record the sales and cost of sales are as follows:

Accounts Receivable.....	XXX	XXX
Sales.....		
Cost of Sales.....	XXX	XXX
Finished Goods.....		

## Factory ledger

A convenient technique in the construction of an accounting system is the use of a factory ledger. Examples of the use of this split-ledger technique are found in cost accounting and also in branch- and home-office accounting.

The basic idea of a split ledger is this: the firm's ledger accounts are physically separated into two groups on a basis decided on by management. To make each ledger self-balancing a *reciprocal* account is put into each ledger in place of the "missing" accounts. For any transaction which involves accounts on both ledgers, two journal entries are made, one for each ledger. Part of each of the two entries will involve the two reciprocal accounts. The two reciprocal accounts have opposite and equal balances; the reciprocal accounts thus cancel out, or "wash out," when the two ledgers are merged together, or trial balances are made from them and combined.

When a factory ledger is used in cost accounting, the manufacturing, or cost, accounts are separated from the general ledger. A special factory journal ordinarily would also be used to summarize data for entry into the factory ledger. The usual journals—cash receipts, cash disbursements, general, sales, voucher register, etc.—are used to summarize data for entry into the general ledger.

Factory ledgers are particularly useful when the factory is geographically separated from the sales and general administrative offices. They also facilitate a division of labor among clerical employees.

The particular accounts which are kept in the factory ledger, rather than in the general ledger, will vary among manufacturing firms. Factory Plant and Equipment and Finished Goods Inventory, for example, might be found in either ledger. Both the factory ledger and the general ledger, of course, may contain control accounts which are supported by subsidiary ledgers. The subsidiary ledger for Factory Plant and Equipment is commonly called the *plant ledger*.

## The cost accounting cycle illustrated

The cost accounting cycle, involving the use of a factory ledger, is illustrated for the Adams Company in Exhibits 2-6 to 2-11. Transactions for the month and the corresponding summary entries for the month appear in Exhibit 2-6. It will be noted that each time the Factory Ledger

## Exhibit

THE ADAMS  
Illustration of

## Transactions

(1) Purchase of raw materials:	
Raw material X.....	\$ 1,000
Raw material Y.....	1,400
Raw material Z.....	600
(2) Raw materials requisitioned and used:	
Requisitioned:	
Raw material X.....	600
Raw material Y.....	800
Used by:	
Department A (or job 1).....	400
Department B (or job 2).....	300
Department C (or job 3).....	700
(3) Labor incurred:	
Direct labor:	
Department A (or job 1).....	1,500
Department B (or job 2).....	2,800
Department C (or job 3).....	1,700
Indirect labor.....	3,000
(4) Overhead applicable to factory:	
Depreciation.....	8,000
Indirect materials.....	1,400
Utilities.....	2,600
(5) Factory overhead assigned or applied to production:	
Department A (or job 1).....	4,000
Department B (or job 2).....	5,000
Department C (or job 3).....	6,000
(6) Completed production transferred to finished goods stockroom:	
From Department A (or job 1).....	5,900
From Department B (or job 2).....	8,100
(7) Goods sold:	
Selling price.....	13,500
Cost.....	10,000
(8) Miscellaneous expenses:	
Selling.....	1,800
Administrative.....	900

account is debited or credited, an offsetting entry is recorded in the reciprocal General Ledger account.

Factory-overhead charges are allocated to the factory in transaction 4. Factory overhead is applied or assigned to production departments (process cost system) or to jobs (job-order cost system) in transaction 5. The basis for allocating overhead charges to the factory and for assigning or applying overhead to departments or jobs is discussed in later chapters.

The factory ledger of the Adams Company is presented in T account form in Exhibit 2-7. Supporting details are maintained in subsidiary ledgers. Subsidiary ledgers are not self-balancing. They merely show the detail of the balance of a control account in either the factory ledger or general ledger.

Subsidiary details for nominal, or income statement, accounts such as those for factory overhead in the illustration frequently are informal memorandum reports, such as a work sheet. It is thus unnecessary to



2-6

# COMPANY

## the Cost Cycle

<i>Journal Entries—Factory Ledger</i>			<i>Journal Entries—General Ledger</i>		
(1) Raw Materials.....	3,000		Factory Ledger Account.....	3,000	
General Ledger Account		3,000	Accounts Payable.....		3,000
(2) Work in Process.....	1,400				
Raw Materials.....		1,400			
(3) Work in Process.....	6,000		Factory Ledger Account.....	9,000	
Factory Overhead.....	3,000		Payroll Accrued.....		9,000
General Ledger Account		9,000			
(4) Factory Overhead.....	12,000		Factory Ledger Account.....	12,000	
General Ledger Account		12,000	Various Accounts.....		12,000
(5) Work in Process.....	15,000				
Factory Overhead.....		15,000			
(6) General Ledger Account.....	14,000		Finished Goods.....	14,000	
Work in Process.....		14,000	Factory Ledger Account....		14,000
			(7) Cost of Sales.....	10,000	
			Finished Goods.....		10,000
			Accounts Receivable.....	13,500	
			Sales.....		13,500
			(8) Selling Expenses.....	1,800	
			Administrative Expenses.....	900	
			Various Accounts.....		2,700

credit each subsidiary Factory Overhead account when factory overhead is assigned or applied to production. When the books are closed at the end of the fiscal period, a new subsidiary record may be started.

For real, or balance sheet, accounts such as raw materials, on the other hand, it may be useful to make both the appropriate debit and credit postings to the subsidiary accounts in order that the "running" balances of the subsidiary accounts agree with the balance of the control account.

After posting the relevant journal entries, the Work in Process account of the Adams Company appears as shown in Exhibit 2-8. The "new beginning inventory" item on the debit side of the account is shown here solely to remind the reader that it is the other half of the "balancing down" entry which is made in balance sheet (or "real") accounts when the accounts are closed at the end of an accounting period.

The manufacturing statement, cost of goods sold statement and the income statement for the Adams Company are presented in Exhibits 2-9 to 2-11.

**Exhibit 2-7****THE ADAMS COMPANY**  
**Factory Ledger**

Raw Materials			
(1)	3,000	(2)	1,400

Work in Process			
(2)	1,400	(6)	14,000
(3)	6,000		
(5)	15,000		

Factory Overhead			
(3)	3,000	(5)	15,000
(4)	12,000		

General Ledger Account			
(6)	14,000	(1)	3,000
		(3)	9,000
		(4)	12,000

**Subsidiary Ledgers***Raw Materials*

Raw Material X			
(1)	1,000	(2)	600

*Work in Process*

Department A or Job 1			
(2)	400	(6)	5,900
(3)	1,500		
(5)	4,000		

*Factory Overhead*

Indirect Labor			
(3)	3,000		

*Raw Material Y*

(1)	1,400	(2)	800
-----	-------	-----	-----

*Department B  
or Job 2*

(2)	300	(6)	8,100
(3)	2,800		
(5)	5,000		

*Depreciation of  
Plant and Equipment*

(4)	8,000		
-----	-------	--	--

*Raw Material Z*

(1)	600		
-----	-----	--	--

*Department C  
or Job 3*

(2)	700		
(3)	1,700		
(5)	6,000		

*Indirect Materials*

(4)	1,400		
-----	-------	--	--

*Utilities*

(4)	2,600		
-----	-------	--	--

**Exhibit 2-8**

**THE ADAMS COMPANY**  
**Work in Process Account**

Debit		Work in Process		Credit	
Costs to account for:				Accounted for as follows:	
Beginning inventory	-0-			Cost of goods manufactured	14,000
Cost of inputs during period:				Ending inventory of work in process	8,400
Materials	1,400				
Direct labor	6,000				
Factory overhead	<u>15,000</u>				
Cost of manufacturing during the period	22,400				
Total costs to account for	<u>22,400</u>			Total costs accounted for	<u>22,400</u>
New beginning inventory	8,400				

**Exhibit 2-9**

**THE ADAMS COMPANY**  
**Manufacturing Statement**  
 For the Month of \_\_\_\_\_

Raw materials purchases.....	\$ 3,000	
Plus or minus change in materials inventory...	<u>-1,600</u>	
Cost of materials used.....	1,400	
Direct labor.....	6,000	
Factory overhead.....	<u>15,000</u>	
Cost of manufacturing during period.....	\$22,400	
Plus or minus change in work in process inventory.....	<u>-8,400</u>	
Cost of goods manufactured.....		<u>\$14,000</u>

**Exhibit 2-10**

**THE ADAMS COMPANY**  
**Cost of Goods Sold Statement**  
 For the Month of \_\_\_\_\_

Cost of goods manufactured.....	\$14,000
Plus or minus changes in finished goods inventory.....	<u>-4,000</u>
Cost of goods sold.....	<u>\$10,000</u>

*Exhibit 2-11*

**THE ADAMS COMPANY**  
**Income Statement**  
 For the Month of \_\_\_\_\_

Sales.....		\$13,500
Cost of goods sold.....		10,000
Gross profit.....		<u>\$ 3,500</u>
Less: Selling expenses.....	\$1,800	
Administrative expenses.....	<u>900</u>	2,700
Income.....		<u><u>\$ 800</u></u>

*Problems and cases*

- 2-1** *Cost systems.* Under what general type of manufacturing conditions would a job-order cost accounting system be appropriate? A process cost accounting system?
- 2-2** *Cost systems.* Indicate some of the features which are common to both process and job-order cost systems. What additional cost information might be provided by a job-order cost system?
- 2-3** *Cost systems.* In what ways do a process and a job-order cost system differ?
- 2-4** Complete the following blank spaces:
1. In a job-order cost accounting system, the Work in Process account is supported by a subsidiary record known as a \_\_\_\_\_.
  2. In a process cost system, primary emphasis is upon assigning costs to \_\_\_\_\_.
  3. Materials used plus direct labor plus factory overhead are called \_\_\_\_\_.
  4. Cost accounts may be separated from the general accounts in a \_\_\_\_\_.
  5. The form used to withdraw materials from the stockroom is called a \_\_\_\_\_.
  6. The form used to allocate the cost of labor among jobs is called a \_\_\_\_\_.
  7. In a process cost system, when units completed are adjusted for partially completed units, for the purpose of calculating unit costs, the result is called \_\_\_\_\_.
- 2-5** *Equivalent units.* Why is it necessary to calculate equivalent units produced rather than actual units completed and transferred, in determining unit product cost?
- 2-6** *Factory ledger.* What are the reasons for establishing a factory ledger?
- 2-7** *Cost systems.* The owner of a garage which repairs automobiles asks you to install a cost accounting system. What costs would you expect to find in this

type of business? What should the objectives of the cost system be? In general terms, outline the type of system that you feel might be appropriate.

- 2-8 *Effect of operations on unit product costs.* The manager of the assembly process of the Dougall Company believes he can improve the performance of his operation by incurring an additional monthly expenditure of \$800. During the past month the total costs incurred in the assembly process amounted to \$8,000, and 1,000 units of product were processed. In the prior month, the total costs incurred in the assembly process amounted to \$7,200, and 900 units of product were processed.

Indicate some possible ways in which the added expenditure of \$800 might be justified by Mr. Dougall either with or without an increase in the average unit product cost.

- 2-9 *Interrelationship of cost accounts with other cost accounts and with the general financial accounts.* For the debits to each of the following accounts, indicate the name of the account or accounts which might be credited, and describe for each the transaction which has taken place (do not assume a split-ledger arrangement):

1. Raw Materials Inventory
2. Raw Materials Used
3. Direct Labor Cost Incurred
4. Depreciation of Factory Equipment
5. Indirect Factory Labor
6. Insurance on Factory
7. Work in Process
8. Finished Goods
9. Cost of Goods Sold

- 2-10 *Split ledgers.* Under a split-ledger arrangement, the cost accounts might be maintained in one ledger, the factory ledger, and the other general and financial accounts might be maintained in another ledger, the general ledger. In this case, the factory ledger might contain an account called General Ledger, and the general ledger might contain an account called Factory Ledger. Under what circumstances are entries made to these two reciprocal accounts? Give an example.

- 2-11 *Flow of paperwork.* Describe the purpose served by each of the following documents which might be found in a cost accounting system:

1. Purchase invoice
2. Receiving report
3. Job cost sheet
4. Departmental cost sheet
5. Overhead distribution analysis
6. Labor time tickets
7. Sales invoice
8. Cash receipt

- 2-12 *Interrelationship of inventories and costs; period costs and product costs; absorption costing.* The cost accounts of the Faville Company contain the following amounts on an absorption cost basis at the end of 1 month's operations, after the usual adjusting entries have been made:



Raw materials used.....	\$ 8,000
Direct-labor cost incurred during period.....	22,000
Factory-overhead cost incurred during period.....	44,000

1. Assuming that there were no beginning or ending inventories of raw materials, work in process, or finished goods, determine the amount of:
  - a. Cost of Manufacturing for the period
  - b. Cost of Goods Manufactured during the period
  - c. Cost of Goods Sold during the period
2. Assuming that the beginning inventory of work in process amounted to \$3,000 and that there were no other beginning or ending inventories, determine the amount of:
  - a. Cost of Manufacturing for the period
  - b. Cost of Goods Manufactured during the period
  - c. Cost of Goods Sold during the period
3. Assuming that the ending inventory of work in process amounted to \$5,000 and that there were no other beginning or ending inventories, determine the amount of:
  - a. Cost of Manufacturing for the period
  - b. Cost of Goods Manufactured during the period
  - c. Cost of Goods Sold during the period
4. Assuming that the beginning inventory of finished goods amounted to \$6,000 and that there were no other beginning or ending inventories, determine the amount of:
  - a. Cost of Manufacturing for the period
  - b. Cost of Goods Manufactured during the period
  - c. Cost of Goods Sold during the period
5. Assuming that the ending inventory of finished goods amounted to \$8,000 and that there were no other beginning or ending inventories, determine the amount of:
  - a. Cost of Manufacturing for the period
  - b. Cost of Goods Manufactured during the period
  - c. Cost of Goods Sold during the period
6. Assuming that the beginning inventory of work in process amounted to \$3,000, that the ending inventory of work in process amounted to \$5,000, and that there were no other beginning or ending inventories, determine the amount of:
  - a. Cost of Manufacturing for the period
  - b. Cost of Goods Manufactured during the period
  - c. Cost of Goods Sold during the period
7. Assuming that the beginning inventory of finished goods amounted to \$6,000, that the ending inventory of finished goods amounted to \$8,000, and that there were no other beginning or ending inventories, determine the amount of:
  - a. Cost of Manufacturing for the period
  - b. Cost of Goods Manufactured during the period
  - c. Cost of Goods Sold during the period
8. Assuming that the beginning inventory of work in process amounted to \$3,000, that the beginning inventory of finished goods amounted to

- \$6,000, and that there were no other beginning or ending inventories, determine the amount of:
- Cost of Manufacturing for the period
  - Cost of Goods Manufactured during the period
  - Cost of Goods Sold during the period
9. Assuming that the ending inventory of work in process amounted to \$5,000, that the ending inventory of finished goods amounted to \$8,000, and that there were no other beginning or ending inventories, determine the amount of:
- Cost of Manufacturing for the period
  - Cost of Goods Manufactured during the period
  - Cost of Goods Sold during the period
10. Assuming that the beginning inventory of work in process amounted to \$3,000, that the ending inventory of finished goods amounted to \$8,000, and that there were no other beginning or ending inventories, determine the amount of:
- Cost of Manufacturing for the period
  - Cost of Goods Manufactured during the period
  - Cost of Goods Sold during the period
11. Assuming that the ending inventory of work in process amounted to \$5,000, that the beginning inventory of finished goods amounted to \$6,000, and that there were no other beginning or ending inventories, determine the amount of:
- Cost of Manufacturing for the period
  - Cost of Goods Manufactured during the period
  - Cost of Goods Sold during the period
12. Assuming that the beginning inventory of work in process amounted to \$3,000, that the ending inventory of work in process amounted to \$5,000, that the beginning inventory of finished goods amounted to \$6,000, and that the ending inventory of finished goods amounted to \$8,000, determine the amount of:
- Cost of Manufacturing for the period
  - Cost of Goods Manufactured during the period
  - Cost of Goods Sold during the period

**2-13** *Interrelationship of inventories and costs; period costs and product costs; direct costing.* Determine the amounts of items 1 through 12 in problem 2-12, assuming a direct-cost basis of costing (materials and direct labor only). The dollar amounts of inventories given in cases 1 through 12 may be assumed to represent direct costs only (materials and direct labor) for purposes of this problem.

**2-14** *Journal entries to effect the flow of costs in the cost accounts.* Using the assumptions in problem 2-12, indicate the journal entries other than closing entries which might be made to record the incurring of the Raw Materials, Direct Labor, and Factory Overhead costs and the flow of costs through the cost accounts. Assume that journal entries are made at the time goods and services go into and out of the factory and out of the firm to customers (perpetual inventory system).

- 2-15 *Preparation of manufacturing statement and income statement.* Using the data in problem 2-12(12), Sales of \$100,000, General and Administrative Expenses of \$9,000, and Selling Expenses of \$12,000, prepare an income statement and a manufacturing statement, using the manufacturing statement as a supporting schedule to the income statement. Use a form of statement which emphasizes changes in inventories.
- 2-16 *Preparation of control statement.* Describe how any of the cost accounting data in problem 2-15 might be reported and used for management control purposes.
- 2-17 *Manufacturing statements.* The Lincoln Manufacturing Company does not maintain a cost accounting system. From the following data prepare a statement of cost of goods manufactured and cost of goods sold and an income statement for the 11 months ended November 30, 1964.

### THE LINCOLN MANUFACTURING COMPANY

Trial Balance  
November 30, 1964

Cash .....	\$ 19,390	
Accounts receivable .....	26,580	
Inventories, Jan. 1, 1964:		
Materials .....	9,640	
Work in process .....	17,340	
Finished goods .....	4,650	
Manufacturing supplies .....	180	
Buildings and equipment .....	48,000	
Machinery .....	80,000	
Real estate .....	30,000	
Allowance for depreciation of buildings .....		\$ 4,800
Allowance for depreciation of machinery .....		12,000
Purchases—materials .....	73,000	
Purchase returns—materials .....		1,410
Freight in—materials .....	820	
Sales .....		300,000
Direct labor .....	103,000	
Indirect labor .....	22,000	
Heat and light .....	1,930	
Power .....	6,200	
Repairs to buildings .....	850	
Compensation insurance .....	2,900	
Fire insurance .....	1,232	
Accounts payable .....		27,140
Capital stock .....		100,000
Surplus .....		54,312
Selling expense .....	26,000	
Administrative expense .....	20,000	
Manufacturing supplies purchased .....	950	
Factory superintendence .....	5,000	
	<u>\$499,662</u>	<u>\$499,662</u>

The following adjustments are found necessary at November 30.

Inventories:	
Materials.....	\$11,360
Work in process.....	\$13,930
Finished goods.....	\$7,250
Manufacturing supplies.....	\$412
Accrued wages:	
Direct labor.....	\$2,000
Indirect labor.....	\$1,000
Accrued power.....	\$170
Depreciation (per annum):	
Buildings and equipment.....	5 %
Machinery.....	7½ %
Prepaid compensation insurance.....	\$180
Prepaid fire insurance.....	\$320
Estimated property taxes for year.....	\$3,600

(AICPA)

**2-18** *Manufacturing statements.* From the following partial list of accounts and transactions of the Hogan Company prepare:

1. A statement of cost of goods manufactured
2. A statement of cost of goods sold
3. An income statement

Assume that no fixed assets have been purchased or retired during the month.

Stores, Jan. 1, 1964.....	\$ 29,000
Purchases of factory materials and supplies.....	65,000
Stores, Jan. 31, 1964.....	26,000
Salaries and wages accrued, Jan. 1, 1964.....	7,000
Salaries and wages accrued, Jan. 31, 1964.....	6,000
Salaries and wages paid.....	74,000
Indirect labor.....	14,000
Administrative and selling salaries.....	17,500
Supplies issued to factory by stores.....	13,000
Factory repairs.....	7,000
Allowance for depr'n—factory plant, machinery, and equipment, Jan. 31, 1964.....	178,000
Allowance for depr'n—factory plant, machinery, and equipment, Jan. 1, 1964.....	172,000
Allowance for depr'n—sales and office equipment, Jan. 31, 1964.....	39,000
Allowance for depr'n—sales and office equipment, Jan. 1, 1964.....	38,000
Taxes and insurance (70 % applicable to plant).....	8,000
Utilities (80 % applicable to plant).....	4,000
Work in process, Jan. 1, 1964.....	22,000
Finished goods, Jan. 1, 1964.....	49,000
Finished goods, Jan. 31, 1964.....	46,000

Cost of goods sold.....	\$128,000
Sales.....	169,000
Miscellaneous selling and administrative expenses.....	7,000

- 2-19 *Process costs.* The Fairchild Chemical Company commenced business on January 1, 1964, producing a single product. Cost and production data for January were as follows:

	<i>Producing Dept. 1</i>	<i>Producing Dept. 2</i>	<i>General Plant</i>
<b>Cost data:</b>			
Materials used.....	\$10,000	-0-	-0-
Direct labor.....	8,000	\$12,000	-0-
Variable overhead.....	2,000	4,000	\$ 4,000
Fixed overhead.....	6,000	10,000	6,000
<b>Total.....</b>	<b>\$26,000</b>	<b>\$26,000</b>	<b>\$10,000</b>
<b>Production data:</b>			
Units completed and transferred.....	9,000	7,000	
Units completed and not transferred..	-0-	1,000	
Units in process ( $\frac{1}{2}$ completed).....	2,000	-0-	

General Plant costs are allocated to producing departments on the basis of direct labor. Included among the 9,000 units transferred out of Department 1 are 1,000 units sold to outsiders at \$2.50 each. In Department 1, material and conversion costs are incurred continuously and uniformly as goods are processed. All units completed in Department 2 are transferred to finished goods. Finished units are sold at \$9 each. On January 31, 1,000 units were in the finished goods stockroom. Selling and administrative expenses during the month amounted to \$8,000.

*Required:*

1. What was the cost per unit in Department 1?
2. What was the cost of a finished unit?
3. Prepare an income statement for January.
4. Assuming that Department 2 is operating at full capacity, was it economically sound to sell 1,000 units of Department 1 output at \$2.50 per unit?

- 2-20 *Flow of costs and cost accounts.* The Shea Company commenced business on July 1, 1962. During the year ended June 30, 1963, it produced 10,000 units of a single product called Tidbit. Two raw materials, Oozit and Doozit, are used in the manufacture of Tidbit. During the year, Tidbit was sold at an average net price of \$22 per unit. From the following data, construct all necessary T accounts, and prepare statements of income, cost of goods manufactured, and cost of goods sold:

1. During the year, 30,000 gallons of Oozit was purchased at \$1 per gallon and 20,000 pounds of Doozit at \$2 a pound.
2. Salaries and wages accrued and paid during the year were as follows:



	<i>Paid</i>	<i>Accrued at end of year</i>
Direct labor.....	\$39,200	\$800
Indirect labor.....	17,600	400
Selling and administration.....	28,000	-0-

3. Other expenses incurred were as follows:

	<i>Factory</i>	<i>Selling and administration</i>
Supplies.....	\$26,500	\$3,000
Repairs.....	10,000	-0-
Utilities.....	6,000	1,200
Depreciation.....	6,000	1,500
Insurance.....	960	240
Taxes.....	1,000	-0-
Miscellaneous.....	1,000	800
Total.....	\$51,460	\$6,740

4. At the close of the year, inventories on hand were as follows:

Oozit.....	1,000 gal
Doozit.....	\$9,000
Tidbit in process.....	-0-
Finished Tidbit.....	500 units

2-21

*Flow of costs and cost accounts.* The Craftex Corporation produces a single product. The first items finished are the first items charged to cost of sales.

*Required:* Complete the following T accounts, and prepare a statement showing the gross profit for January and a supporting statement showing how it was derived.

<i>Sales</i>		<i>Finished Goods</i>	
	(Av'ge unit price \$12) 36,000	1/1 bal. (200 units) 2,300	
			1/31 bal. (100 units)
<i>Cost of Sales</i>		<i>Work in Process</i>	
		1/1 bal. -0-	
			1/31 bal. -0-

Factory Overhead		Stores (Raw Materials and Supplies)			
Depr'n	1,300	1/1 bal.	2,900	Supplies	
Utilities	600	Purchases	13,600	Issued	3,000
Taxes	300			Returned	
Insurance	300			Purchases	1,500
Repairs	1,200			1/31 bal.	2,000
Miscell.	800				

Accrued Factory Payroll	
12,900	Indirect Labor 3,500
	Direct Labor 11,000

- 2-22 *General and factory ledgers.* The Sitrite Company manufactures seat covers for automobiles. It has two productive departments, sewing and finishing. All sewed covers are transferred to finishing and all finished covers are shipped to company warehouses. The company started business on January 1, 1963. A separate ledger is maintained by the factory. The results of the factory's operations are reflected in the following data, for the first quarter of 1963.

*Required:* Based on the data shown, record all summary journal entries that were made on the factory journal and the offsetting entries, where necessary, on the general journal.

### THE SITRITE COMPANY Factory Accounts

	Debits	Credits	Balance, Jan. 31, 1963
Raw materials.....	\$280,000	\$250,000	\$ 30,000
Work in process—sewing.....	344,000	290,000	54,000
Work in process—finishing.....	430,000	350,000	80,000
Factory overhead—sewing.....	60,000	60,000	—0—
Factory overhead—finishing.....	80,000	80,000	—0—
General ledger control.....	?	?	164,000

### Raw Materials Subsidiary Ledger

Raw Materials	Purchases	Returned to Suppliers	Disbursed to Sewing Dept.	Balance, Jan. 31, 1963
A	\$ 89,000	\$2,000	\$ 78,000	\$ 9,000
B	110,000	4,000	88,000	18,000
C	81,000	—0—	78,000	3,000
Total	<u>\$280,000</u>	<u>\$6,000</u>	<u>\$244,000</u>	<u>\$30,000</u>

## Trial Balance—Factory Overhead Subsidiary Ledger

	<i>Sewing Dept.</i>	<i>Finishing Dept.</i>
Supplies.....	\$14,000	\$19,000
Indirect labor.....	24,000	34,000
Depreciation.....	4,000	6,000
Repairs.....	8,000	7,000
Utilities.....	3,000	4,000
Taxes.....	2,000	3,000
Insurance.....	1,000	1,500
Miscellaneous.....	4,000	5,500
Total.....	<u>\$60,000</u>	<u>\$80,000</u>

- 2-23 *Interrelationship of cost accounts and financial accounts.* The Smith Company commenced operations on July 1. The following shows the gross debits and credits in each account of the ledger as of December 31 except for the work-in-process and finished goods inventory accounts. The company uses a cost system for its manufacturing operations.

## THE SMITH COMPANY

## Trial Balance

December 31

	<i>Transactions</i>		<i>Balance</i>	
	<i>Dr.</i>	<i>Cr.</i>	<i>Dr.</i>	<i>Cr.</i>
Cash.....	\$464,000	\$370,000	\$ 94,000	
Notes receivable.....	20,000	12,000	8,000	
Accounts receivable.....	340,000	302,000	38,000	
Raw materials.....	125,000	118,000	7,000	
Finished goods.....	Compute	Compute	30,000	
Work in process.....	Compute	Compute	14,000	
Factory supplies.....	18,000	14,000	4,000	
Prepaid insurance.....	1,900	1,500	400	
Plant and equipment.....	95,000	—0—	95,000	
Mortgage payable.....	—0—	50,000		\$ 50,000
Accrued mortgage interest....	—0—	750		750
Accrued wages.....	145,100	147,000		1,900
Capital stock.....	—0—	150,000		150,000
Vouchers payable.....	325,000	365,500		40,500
Sales.....	—0—	360,000		360,000
Cost of goods sold.....	250,000	—0—	250,000	
Selling expense.....	27,500	—0—	27,500	
Administrative expense.....	29,000	—0—	29,000	
Financial expense.....	6,250	—0—	6,250	
			<u>\$603,150</u>	<u>\$603,150</u>

You are also given the following information:

1. The ending Work in Process Inventory consists of the following: Materials \$6,000; Direct Labor \$4,500; Manufacturing Expense \$3,500.

2. Insurance premiums apply two-thirds to the plant and one-third to the office. Sales salaries and administrative salaries were \$20,000 and \$10,500, respectively, of the total wages expense.
3. The cost of the finished product is made up of: Materials 40%; Labor 40%; Manufacturing Expense 20%.

You are to show the entries making up the transactions included in the figures shown on the trial balance. (*Suggestion: Use T accounts; begin with Cost of Goods Sold, and work back to costs and expenses first. Key each entry by use of a number.*)

(AICPA adapted)

Bushan Lal Bhat  
(I.C.W.A. '1981)  
Year.

### 3. **Materials Costs— Accounting and Control**

#### *Materials control*

##### **Nature of raw materials and supplies**

Materials which actually form a part of the finished product are known as direct materials. Those which are minor in importance, such as small, relatively inexpensive pins or screws, or which do not physically become a part of the finished product, such as polishing materials, are called indirect materials or supplies.

Factory supplies, office supplies, and selling supplies are types of materials that are sometimes included under the general description of "stores," since frequently these are all combined and administered by a single storage function in an organization. If this procedure is followed, the supplies are inventoried initially, charged to Stores when acquired, and then, as they are used, they are charged to appropriate cost or expense accounts. When consumed, factory supplies are charged to Factory Overhead, which is an inventoriable cost. Office supplies and selling supplies are charged to General, Administrative, and Selling Expenses as expenses of the period.

Often a firm subcontracts with another manufacturer to produce finished parts which will then be assembled and processed further by the prime contractor into a finished product. Such materials are referred to as *finished parts*, or *subcontracted parts*. A manufacturing firm itself may produce component parts in subassemblies which are assembled into finished products in main assemblies.

##### **Objectives of materials control**

A manufacturing firm's investment in inventories generally represents a significant portion of its current assets. Maintaining a properly balanced inventory investment requires careful planning and control. Excessive inventories result in higher inventory carrying costs, including losses due to spoilage, additional storage space, and unproductive use of capital funds. On the other hand, inventory shortages result in production



stoppages, excessive setup costs, and higher ordering and invoice-processing costs. It is important, therefore, for a company to exercise close control over its inventory investment.

The objectives of materials control may be listed as follows:

1. No unauthorized commitment of the firm's funds should be made for materials by operating departments where centralized purchasing is used.
2. Materials which were not ordered or which are not in accordance with the specifications ordered should not be accepted.
3. Materials should not be accepted unless provision is made for adjustments with the vendor for shortages or damaged goods.
4. There should be assurance that materials actually have been received and the proper prices charged for all expenditures made.
5. There should be adequate physical control over the storage of inventory.
6. Proper cost control should be exercised over the quantities of materials and supplies used by operating personnel.
7. There should be a proper balance between the dollar investment in inventories and the costs incurred in the acquisition, utilization, and storage of materials as well as losses due to production stoppages or lost sales caused by lack of stock.

### Organizational responsibilities for materials control

Figure 3-1 traces the materials cycle from placement of purchase order to replacement of materials used. In order to maintain a systematic control over materials, many firms use a routine which coordinates the various phases in the materials cycle and assigns responsibility for materials control to the several functions involved. Because of differences in organizational structures, responsibilities for materials control vary from company to company. In many concerns, responsibility for different phases of materials control are assigned to the following functions: (1) purchasing, (2) receiving and inspection, (3) stores, (4) factory production departments, and (5) materials planning.

### Purchasing

The purchasing department is responsible for the acquisition of materials at the lowest net price consistent with the specifications stipulated by the requisitioning department. The purchasing department also is responsible for planning the delivery of materials so that interruptions in the production schedule will not occur because of material shortages.

The initiation of a purchase begins with the receipt of a *purchase requisition* by the purchasing department. This form is prepared by a person authorized to order materials or supplies. It may originate in materials planning, stores, or other factory departments as well as in

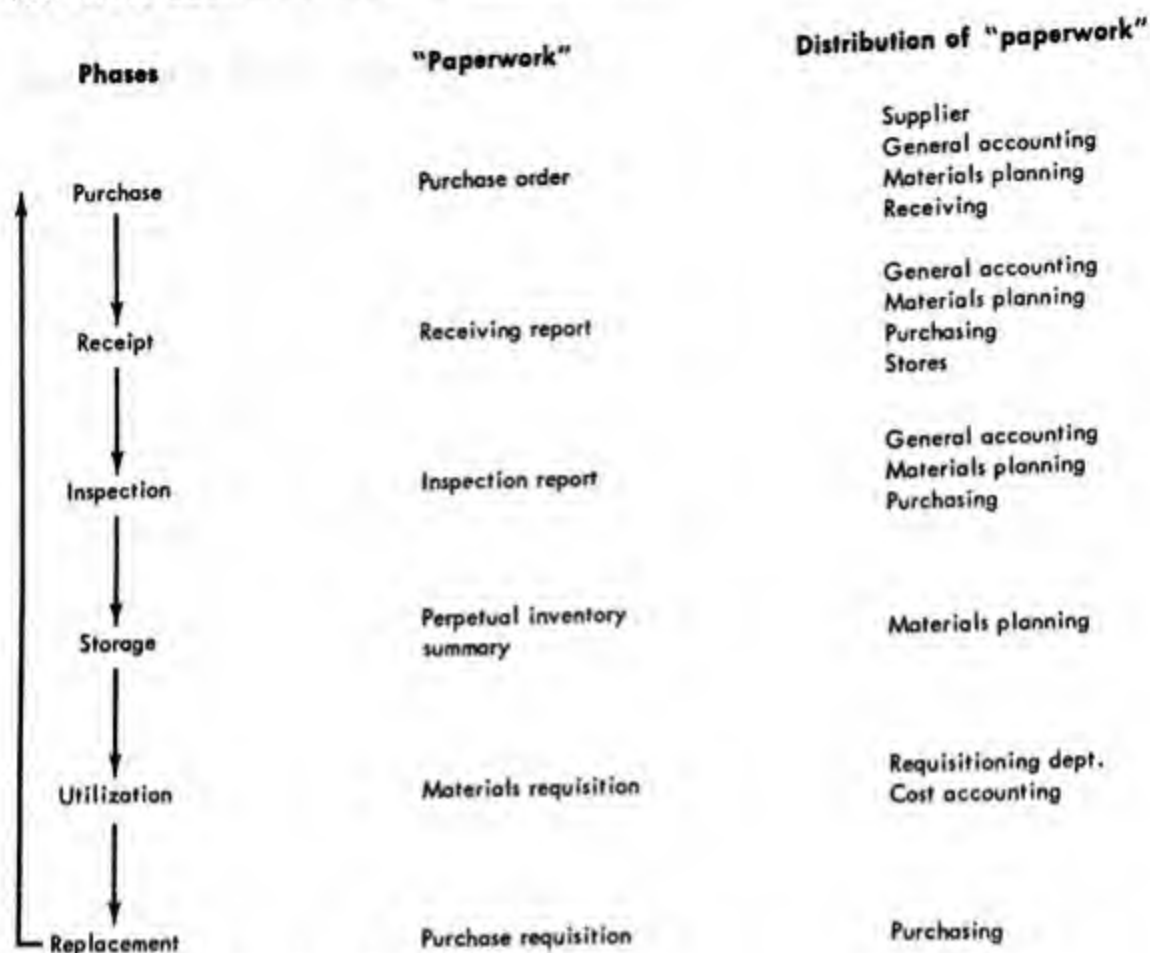


Fig. 3-1 The materials cycle.

administrative or sales departments. The purchase requisition indicates the quantity of each item desired, the date desired, and a suggested supplier.

The *purchase order*, which is prepared in the purchasing department and forwarded to the vendor, is a written authorization to the supplier to deliver the quantity of each type of material specified, at the terms stipulated and at the time and place mentioned.

The responsibilities of the purchasing department include:

1. Obtaining price quotations from vendors for items appearing on purchase requisitions received.
2. Selecting between alternative suppliers after giving effect to price, quality, delivery time cycle, and freight cost.
3. Deciding on optimum size of purchase order after giving consideration to quantity discounts, freight savings on large orders, materials handling, ordering costs, space limitations, and the cost of capital tied up in inventories.
4. Preparing purchase orders and forwarding them to vendors. Gener-

ally, multicopy orders are prepared which serve the following purposes:

- a. Authorizes vendor to make shipment.
- b. Notifies receiving department of goods to arrive in future.
- c. Advises materials planning or other requisitioning department that order has been placed.
- d. Notifies general accounting department of purchase commitment.

### Receiving and inspection

The receiving and inspection department is responsible for receiving authorized shipments, inspecting the contents, filing appropriate forms, and transporting goods to stores.

The receiving and inspection department normally performs the following functions:

1. Receives and inspects goods and verifies the quantities with purchase order and packing slip.
2. Prepares reports on shortages, damages in transit, and returns to vendors.
3. Prepares receiving report for distribution to various departments.
4. Delivers goods to stores.

The principal document prepared in the receiving department is a *receiving report* (Fig. 3-2). Generally, the receiving report contains provision for comments regarding the condition of the shipment. However, in some companies a separate inspection report is prepared, particularly where very costly and highly calibrated materials are received. The receiving report is a basic document in a company's system of internal control. The copy forwarded to the general accounting department provides a comparison between the actual quantities received and those appearing on the supplier's invoice. Copies of the receiving report also are sent to stores (so that space can be provided and perpetual inventory records notated), to purchasing (for follow-up on orders placed), and to materials planning (for inventory planning purposes).

### Stores

The role of the stores department is as follows:

1. Receives and verifies quantities of goods and places them in storage.
2. Enters receipts on stores ledger card (Fig. 3-3), if this record is maintained in stores rather than in materials planning, purchasing, or cost accounting.
3. Disburses materials to factory upon receipt of properly authorized forms called materials requisitions (Fig. 3-4).

Storeroom losses may result from deterioration, breakage, theft, and inability to locate items when needed. These losses can be minimized through efficient storeroom procedures. Normally, the storeroom is divided into sections, bays, bins, etc. *Bin tags* are maintained which show the quantity and location of each item in the storeroom. The location,

No. <u>10,008</u>		
Armstrong Manufacturing Co.		
<b>RECEIVING REPORT</b>		
Vendor <u>Acme Supply</u>	Date <u>4/4/64</u>	
Address <u>Main St., Peru, Ind.</u>	P.O. No. <u>9,639</u>	
Carrier <u>Interstate Trucking</u>	For <u>Machining</u>	
Freight Bill No. <u>R754639</u>	Acct. <u>106</u>	
Packing Slip No. <u>C 47368</u>		
Bill of Lading No. <u>72711</u>		

Quantity	Item	Description
30	801-6	Drill bits

Received by: <u>J.K.</u>		
<b>INSPECTION REPORT</b>		
No. of cartons <u>1</u>	Condition <u>good</u>	Inspected by <u>R.L.</u>
Rejects		

Item	Quantity	Reason

Fig. 3-2 Receiving report.

degree of control exercised, and allocation of space to specific items depends on their characteristics, e.g., frequency of use, cost, size.

It sometimes is more economical not to maintain a formal paperwork accountability or requisitioning procedure for certain items of raw materials or supplies. This may be advisable for items which are least likely to be personally useful to employees and for relatively inexpensive items or for materials which are used in large quantities in production, e.g., raw milk, crude oil, sand, coal.

Armstrong Manufacturing Co.

**STORES LEDGER CARD**

Item Motor Minimum quantity 50  
 Description G.E. 1/4 h.p. Reorder quantity 20

Received					Issued					Balance		
Date	Rec. No.	Qty.	Unit Cost	Amount	Date	Req. No.	Qty.	Unit Cost	Amount	Qty.	Unit Cost	Amount
2/1	9862	20	18.00	360.00						60	18.00	1080.00
					2/7	3872	4	18.00	72.00	56	18.00	1008.00

Fig. 3-3 Stores ledger card.

No. 12680

Armstrong Manufacturing Co.

**MATERIALS REQUISITION**

Deliver to Assy. Date 5/2/64  
 Approved by T.L.F. Charge to Job 109

Item	Qty.	Number	Description	Qty. Issued	Unit Cost	Total Cost
Paint	3 qts.	113-A	Blue Enamel	3 qts.	3.50	10.50

Filled by R.Y. Priced by T.S. Rec'd by H.H. Date rec'd 5/2/64

Fig. 3-4 Materials requisition.

**Production departments**

Materials control extends into the factory, where raw materials are utilized in production. Factory control over raw materials may be exercised in the following ways:

1. Comparing the actual quantities of materials used per unit of out-



*Exhibit 3-1*

Materials Utilization Report  
Mixing Department  
Week Ended \_\_\_\_\_

<i>Period.....</i>	<i>This week</i>		<i>Last week</i>	<i>Year to date</i>
<i>Units produced.....</i>	<i>10,000</i>		<i>8,000</i>	<i>130,000</i>
<i>Raw materials used</i>	<i>Total, lb</i>	<i>Pounds per 100 units</i>	<i>Pounds per 100 units</i>	<i>Pounds per 100 units</i>
Woodflour.....	10,850	108.5	106.7	106.3
Starch.....	4,630	46.3	44.2	44.0
Resin.....	1,005	10.1	9.8	9.8

put during the current period with corresponding data for preceding periods. An illustration of this type of control report appears in Exhibit 3-1. Presumably, the supervisor of the mixing department will seek explanations and take measures to eliminate the unfavorable trend shown for materials utilization.

This method has greatest applicability to companies producing a single product, e.g., milk, bread, refined sugar. However, it may prove misleading if used by multiproduct companies. In such situations, the amount of raw materials used is affected by the mixture of products manufactured as well as the efficiency with which raw materials have been utilized.

2. Establishing standard quantities of raw materials for each unit of product manufactured and comparing the actual quantities used with the standard or allowed quantities. During a period of time, the total standard quantities of a particular raw material that should have been used is calculated by multiplying the standard quantity per unit of product by the number of units manufactured. This may be illustrated by assuming that the engineering department of a firm has established the following raw materials standards for products X, Y, and Z:

<i>Raw material</i>	<i>Standard quantities per unit</i>		
	<i>Product X</i>	<i>Product Y</i>	<i>Product Z</i>
a	10 lb	8 lb	6 lb
b	23 pc	18 pc	12 pc
c	4 lb	3 lb	3 lb

During a particular week the following actual results occurred:

Production:	
Product X.....	6,000 units
Product Y.....	4,000 units
Product Z.....	5,000 units
Raw materials used:	
Item a.....	134,000 lb
Item b.....	275,000 pc
Item c.....	48,000 lb

Exhibit 3-2 shows how these data might be presented in a materials utilization report.

3. Issuing scrap reports. In companies where finished products must conform to close tolerances, e.g., precision instruments, condensers, electronic tubes, scrap losses often represent a significant portion of the total product cost. In such situations, as an item is scrapped, a *scrap ticket* is prepared which contains such information as the part number of item scrapped, processing stage at which scrap occurred, employee respon-

**Exhibit 3-2**

Materials Utilization Report  
 \_\_\_\_\_ Department  
 Week Ended \_\_\_\_\_

Raw material used	Actual quantities	Standard quantities	Variance	Efficiency, %
a	134,000 lb	122,000 lb	(12,000)	90.3
b	275,000 pc	270,000 pc	(5,000)	98.2
c	48,000 lb	51,000 lb	3,000	106.2

**Exhibit 3-3**

Daily Scrap Report

Part no.	Cost of scrap	Causes	Amount	Percent of total
1056	\$ 809	Operator inefficiency.....	\$2,109	28.0
681	465	Defective materials.....	680	9.0
136	1,263	Poor dies.....	1,263	16.8
964	2,200	Machine alignment.....	2,100	28.0
871	1,400	Materials handling.....	665	8.8
321	710	Other.....	710	9.4
804	680			
Total.....	\$7,527	Total.....	\$7,527	100.0

Cost of good items..... \$84,560

Scrap as percent of good items..... 8.9%

sible, and cause for scrapping. The cost accounting department may now attach costs to the scrapped items and prepare a daily scrap report as shown in Exhibit 3-3.

### Establishing the optimum size of materials inventory

In general, two methods are used for establishing the desired inventory balances of raw materials to be carried: (1) inventory turnover rates and (2) lowest combined total ordering and carrying costs.

1. Inventory turnover rates. Exhibit 3-4 presents a report of the status of the materials inventory of the Keith Corporation as of December 31, 1964. The turnover rates shown are calculated by dividing the total cost of each materials item used during the past year by the cost on hand and on order at the close of the year. As indicated, this relationship also may be expressed in terms of the number of months' usage represented by the inventory on hand and on order. Presumably, the company's management will establish a standard or target turnover rate, based on past experience and its judgment of future operating conditions, with which actual turnover rates can be compared.

Although commonly used, this method is not theoretically sound. It does not give consideration to ordering costs, purchase discounts obtained on large orders, freight savings on large shipments, inventory carrying costs, etc. Because of these factors, under certain circumstances it may be more economical to deliberately maintain a low turnover rate for particular items.

#### Exhibit 3-4

#### THE KEITH CORPORATION Status of Materials Inventory As of December 31, 1964

Item	On hand	On order	Total	Used during 1964	Turn-over rate	Months' supply on hand
Sockets.....	\$ 1,600	-0-	\$ 1,600	\$ 4,800	3.0	4.0
Plugs.....	400	\$ 200	600	1,400	2.3	5.2
Wire.....	4,900	1,600	6,500	10,600	1.6	7.4
Ceramic bases.....	18,000	-0-	18,000	72,000	4.0	3.0
Metal bases.....	3,600	-0-	3,600	6,000	1.7	7.1
Wooden bases.....	6,400	-0-	6,400	5,000	.8	15.0
Shades—style:						
A-100.....	1,200	-0-	1,200	6,800	5.7	2.1
A-101.....	800	-0-	800	900	1.1	10.9
A-102.....	700	500	1,200	2,900	2.4	5.0
A-103.....	900	-0-	900	1,900	2.1	5.7
Fixtures.....	1,100	-0-	1,100	3,600	3.3	3.6
	\$39,600	\$2,300	\$41,900	\$115,900	2.8	4.3

2. Lowest combined total ordering and carrying costs. Raw materials inventory costs can be divided into two broad categories: (a) ordering and related costs and (b) carrying costs. In this type of decision only incremental and opportunity costs are relevant. Included in order-processing costs are purchasing, invoice processing, quantity discounts, and freight savings. Carrying costs include materials handling, the value of storage space and facilities required, deterioration, and interest on capital funds invested in inventories.

Costs in these two categories move in opposite directions. When the average size of purchase orders is increased, total ordering and related costs decrease, since fewer orders are processed and freight and discount savings occur. However, when larger orders are placed, the size of the average inventory on hand also rises, since it is equal to approximately one-half of the amount of the purchase order. If the average inventory size is greater, inventory carrying costs rise, since more space is required, interest is lost on excess funds tied up in inventories, more deterioration takes place, etc. The optimum inventory size is achieved when the combined total ordering and carrying costs are at their lowest point.

This may be illustrated by assuming the following facts for a single raw materials item:

Invoice price.....	\$5
Annual quantity required.....	1,000 units
Ordering costs per order.....	\$8
Inventory carrying costs as a percent of invoice price.....	15%

*Exhibit 3-5*

Calculation of Optimum Inventory Size\*

Number of orders	Units per order	Average inventory ( $\frac{1}{2}$ order)	Average inventory cost (\$5 per item)	Inventory carrying cost (15% inventory cost)	Order- processing cost (\$8 per order)	Total combined order-processing and inventory carrying costs
1	1,000	500	\$2,500	\$375	\$ 8	\$383
2	500	250	1,250	188	16	204
3	333	166	830	125	24	149
4	250	125	625	94	32	126
5	200	100	500	75	40	115
6	167	83	415	62	48	110
→7	143	71	355	53	56	109←
8	125	63	315	47	64	111
9	111	56	280	42	72	114
10	100	50	250	37	80	117

\* Arrow indicates optimum inventory size.

In Exhibit 3-5, it will be seen that the lowest combined total ordering and carrying costs occur if the annual requirement (1,000 units) is filled in seven orders of 143 units each. This results in an average inventory size of \$355. These calculations may be simplified through the use of formulas and other techniques. However, there are many ramifications to the use of this method. They will be explored in greater depth in Chapter 20.

## *Accounting for materials*

### **Elements of materials cost**

The cost of materials used in production includes at least the invoice cost of the materials purchased. Other cost items which may be treated as elements of materials cost include transportation charges incurred and borne by the purchaser, purchase discounts allowed (a reduction in materials cost), receiving and inspecting, and storage.

Including these costs in the materials cost makes them inventoriable costs. As such, they are a part of the raw materials inventory on the balance sheet, and they are recognized in the income statement as a part of the cost of goods sold, in the period of the sale, of the finished products for which the materials were utilized.

The alternative to accounting for these cost items as elements of materials cost is to account for them as period expenses recognized in the period in which they are incurred. In this event, they do not appear on the income statement as a part of the cost of goods sold but rather as the separate expense items of freight in, purchase discounts taken (a negative item), or costs of storage such as warehouse rent or salaries of stores personnel.

The handling of these costs as period expenses may be the simplest method. The practice of inventorying them, however, results in a periodic income figure which is more nearly in accord with the goal of matching related production costs with the sales revenue of the period. In addition, the identification of these costs as part of materials costs is more useful for decision-making analyses.

### **Illustration of transportation and storage costs**

Assume that the Heebink Company purchased raw materials at a cost of \$100,000 and used them to produce goods in 1964, with direct-labor and factory-overhead costs of \$120,000, which were sold in 1965 for \$250,000. Assume further that transportation costs incurred in delivering the raw materials to the factory in 1964 amounted to \$2,000 and that the cost of storing the raw materials prior to their use in production amounted to \$5,000. Ignoring selling, administrative, and other expenses, the effect on income for 1964 and 1965 under the two methods of accounting for transportation and storage costs is shown in Exhibit 3-6.



## Exhibit 3-6

**THE HEEBINK COMPANY**  
**Transportation and Storage Costs as Product or Period Expense**

	1964	1965
Transportation and storage costs as elements of inventoriable materials cost:		
Sales.....	-0-	\$250,000
Cost of goods manufactured and sold.....	-0-	227,000
Gross profit.....	-0-	\$ 23,000
Transportation and storage expenses.....	-0-	-0-
Contribution to other expenses and income.....	-0-	\$ 23,000
Transportation and storage costs as period expenses:		
Sales.....	-0-	\$250,000
Cost of goods manufactured and sold.....	-0-	220,000
Gross profit.....	-0-	\$ 30,000
Transportation and storage expenses.....	\$ 7,000	-0-
Contribution to other expenses and income.....	\$(7,000)	\$ 30,000

In the illustration, the \$7,000 of transportation and storage costs are recognized in the period of the sale of the goods, when they are treated as elements of materials cost which are inventoried. Thus, the accounting objective of matching revenues and costs is adhered to. It should be noted, however, that when the rate of materials purchases and the rate of production and sale of goods does not change materially from period to period, substantially the same income results are achieved under either method, assuming constant transportation and storage expense.

### Normalizing transportation, storage, and other costs related to materials

The decision to treat transportation and storage costs as elements of materials cost is accompanied by the problem of identifying such costs with *specific units* of materials. Freight charges, which ordinarily are based upon weight, might be assigned on a specific identification basis to the invoice cost of each materials shipment. Where there are several items in a shipment with differing weights, the freight charges might be allocated among the items on the basis of the relative invoice costs of each item in the shipment regardless of weight.

A normal transportation charge based upon past experience and future estimates also can be used in costing materials received. Assume that, on the average, transportation charges for a firm amount to 10 cents per \$1 of materials purchased. As transportation costs are incurred, they would be accumulated in a Transportation Expense account. As materials are received, the normal transportation charge of 10 percent would be

credited to Transportation Expense and charged to Materials Inventory Control or Purchases of Materials. Storage, purchasing, receiving, inspecting, and other costs directly related to materials might also be charged to materials on a normal or average basis.

**Methods of accounting for cash discounts on materials purchased**  
Vendors frequently offer cash discounts to customers who pay their bills within a certain discount period. Payment terms of 2/10, n/30, for example, indicate that a 2 percent discount is to be allowed if payment is made within 10 days of the invoice date. The entire amount of the bill is due, at the latest, in 30 days.

Two methods of accounting for purchase discounts are the following, each consisting of two steps.

Method 1 consists of:

1. Recording the *gross* invoice price at the time of purchase

2. Recognizing the allowed purchase discount as an income item, Purchase Discounts Taken, at the time payment is made

Method 2 consists of:

1. Recording the *net* invoice price (gross price minus anticipated discount) at the time of purchase

2. Recognizing purchase discounts *not taken* as an expense or loss item, Purchase Discounts Lost, at the time payment is made

To illustrate the two techniques, assume that the Crosby Company purchases materials at a gross invoice price of \$3,000 with terms of 2/20, n/60. Entries to be made under the two methods, assuming payment within the discount period and payment after the discount period, are summarized in Exhibit 3-7.

### Exhibit 3-7

#### THE CROSBY COMPANY Accounting for Purchase Discounts

		<i>Payment within discount period</i>	<i>Payment after discount period</i>
<b>Method 1:</b>			
(1) Materials Inventory or Purchases	3,000		
Accounts Payable		3,000	
(2) Accounts Payable	3,000		3,000
Cash		2,940	3,000
Purchase Discounts Taken		60	
<b>Method 2:</b>			
(1) Materials Inventory or Purchases	2,940		
Accounts Payable		2,940	
(2) Accounts Payable	2,940		2,940
Purchase Discounts Lost			60
Cash		2,940	3,000

From a management control point of view, the second method has the advantage of revealing purchase discounts which have been lost and of recognizing purchase discounts lost in the period in which they are actually lost.

### *Illustrative accounting entries*

#### **Materials acquisition**

The accounting entries for recording the acquisition of materials by the Nickerson Company are illustrative. The company treats purchase discounts as a reduction in materials cost and normalizes its transportation, storage, purchasing, receiving, and inspecting costs as elements of materials cost.

(1)

(Receipt of 70 units of material A ordered from vendor X. Gross invoice cost, \$1,500. Terms: 2/10, n/60.)

Materials Inventory (or Purchases).....	1,470	
Accounts Payable.....		1,470

(2)

(Return to vendor of 20 units of inferior material received as part of shipment in transaction 1. The return is for credit.)

Accounts Payable.....	420	
Materials Inventory (or Purchases).....		420

(3)

(Payment of purchase from vendor X within discount period)

Accounts Payable.....	1,050	
Cash.....		1,050

Normal transportation, purchasing, receiving, and inspecting costs are charged to the retained units of material A purchased. The transportation charge is based upon the cost of materials and amounts to 6 percent. The charge for purchasing cost is estimated to be \$2 per order. The normal receiving and inspection charge is 80 cents per unit of material.

(4)

Materials Inventory (or Purchases).....	105	
Transportation Expenses.....		63
Purchasing Department Expenses.....		2
Receiving and Inspection Expenses.....		40

The actual expenses of transporting, purchasing, receiving, and storing materials are accumulated in the respective expense accounts as they are paid or incurred.

The Nickerson Company uses a perpetual inventory system in accounting for materials. The Material A subsidiary record which supports the Materials Inventory Control account appears, after the transactions above, as shown in Exhibit 3-8.

*Exhibit 3-8*

**THE NICKERSON COMPANY**  
**Subsidiary Record—Material A**

<i>Material A receipts</i>		<i>Issues</i>		<i>Balance</i>	
70 units @ \$21	\$1,470	20 units	\$420	70 units @ \$21.00	\$1,470
				50 units @ \$21.00	1,050
Charges	105			50 units @ \$23.10	1,155

The unit cost of material available for use in production, including the normal transportation, purchasing, receiving, and storing charges, and reduced by the purchase discount taken, is \$23.10.

### Utilization of materials

A materials requisition or standard bill of materials may be used as the authorization and basis of accountability for issuances of materials. A materials requisition indicates item, quantity, unit cost, extension, requisitioning department, individuals approving, and the job cost sheet to be charged. A standard bill of materials is a listing of the quantities of each type of material which should be necessary to complete a particular job or product.

The summary entry for the issuance of 10 units of material A to the fabrication department of the Nickerson Company is:

Work in Process . . . . .	231	
Materials Inventory . . . . .		231

The perpetual inventory which is maintained by the Nickerson Company for materials, as a subsidiary record, is credited for materials issued. If the materials are to be used on a specific job for which a job cost sheet is maintained, the job cost sheet—which is the subsidiary record of Work in Process—is charged for the cost of materials used in production. It is necessary usually to make entries in the subsidiary records more frequently than in the control accounts in order that the quantity of the various types of material on hand is known.

When the factory returns unused materials to the storeroom, a returned materials report may be prepared and an entry would be made in the control and subsidiary accounts to reverse the entry for the issuance of material.

The Nickerson Company also maintains a perpetual inventory for finished goods similar to that for raw materials. The quantity and unit cost information for finished goods received by the finished goods storeroom is taken from the job cost sheet for the finished production.



### Perpetual, periodic, and physical inventories

The formula for accounting for cost of materials used in production is:

Costs to account for:		Accounted for as:	
Beginning inventory	-0-	Materials used	231
Purchases of materials	1,155	Ending inventory	924
Total	<u>1,155</u>	Total	<u>1,155</u>

Under a perpetual inventory system, the book figure for the ending inventory is a balancing figure on the accounts, which may be verified periodically by actually counting the items physically. This counting is referred to as "taking a physical inventory."

Under a periodic inventory procedure, where a perpetual inventory is not maintained, a physical inventory is taken periodically, and the cost of materials used is the balancing figure in the accounts. In this situation, the cost of materials used is perhaps more accurately described as the cost of materials which are *assumed* to have been used.

From a management control standpoint, a perpetual inventory system, together with a materials requisition system, is a technique for control. When a perpetual inventory system is used, discrepancies between the "book" figure and the actual physical inventory count might be due to either clerical errors or theft of materials. An examination and rechecking of requisitions and postings to the perpetual inventory records can reveal discrepancies due to posting errors. Under a periodic inventory arrangement where no perpetual record is maintained, there is no "paper-work trail" which can be retraced.

To alleviate some of the year-end time pressure of an annual physical inventory, many firms use a technique called the *cycle, continuous, or rotating* method of taking inventory. Under this arrangement, different items in the inventory are counted and verified with the perpetual record each day, week, or month throughout the year.

### Adjusting the Raw Materials account and stores ledger cards for physical inventory discrepancies

Taking a physical inventory is an expensive operation. Prior to taking the inventory, it usually is desirable to arrange the stockroom to facilitate the counting process. Generally, it is necessary to halt manufacturing activities during the period when the inventory is being counted. Verifying material costs and preparing inventory sheets also is time-consuming. Nevertheless, for external reporting purposes, a complete physical inventory count normally is made at the close of each year.

The physical count of raw materials may be expected to disclose at least some differences from those quantities shown on the stores ledger cards. As a consequence, both the stores ledger cards and the Raw Mate-



rials Control account require adjustment. The inventory difference may be charged or credited to the Factory Overhead account and to an Inventory Over-or-Short account in the subsidiary ledger, with an offsetting entry recorded in the Raw Materials account. Subsidiary stores ledger records also must be adjusted. Inventory overages are recorded under "receipts" and shortages under "disbursements" on the appropriate stores ledger cards.

### *Methods of costing materials used*

Because of changing prices, the cost per unit of purchased materials may fluctuate through time, and the inventory may contain identical items acquired at different costs. When a firm uses only small quantities of materials in production, it is not too difficult to tag the materials with the actual, specifically identifiable invoice cost.

Under the specific-identification costing method, the cost tags are removed from the materials as they are sent to production. This cost figure, which was determined originally by an examination of specific invoices, is used for cost accounting purposes. For income determination purposes, this method may be objectionable because of the ease with which arbitrary cost and income manipulation may be accomplished through the choice of the particular units of identical materials used. Specific identification cost may, however, be appropriate where special materials are carried for made-to-order production in a job shop.

In the more usual case in which large quantities of materials are involved in production, it is impractical to identify unit purchase cost with each individual item of material. In such cases, some pattern must be adopted for costing the materials requisitions, charging work-in-process control and subsidiary accounts, and crediting the perpetual inventory for materials. Some of the more frequently used methods of costing materials used are:

1. First-in, first-out (Fifo)
2. Last-in, first-out (Lifo)
3. Moving-average cost
4. End-of-month average cost (EOM)
5. Standard cost
6. Base stock method

All the costing methods, with the exception of the base stock method, have had occasional or recurring approval for Federal income tax purposes.

### **Flow of materials and flow of costs**

First-in, first-out (Fifo) means that the unit costs of the earliest purchased materials still in inventory are used first to cost the materials consumed during the period. When the materials consumption is suf-

ficient to exhaust the earliest purchase costs, additional usages of materials are costed using the unit costs of the second purchase during the period, etc.

Last-in, first-out (Lifo) is the opposite of Fifo. Under Lifo, issues of materials during a period of time are costed at the latest purchase cost, then the next latest purchase cost, etc.

It should be emphasized that the pattern of cost flow does not necessarily coincide with the actual flow pattern of the materials themselves; i.e., the use of Fifo does not necessarily mean that the oldest materials are used first. Rather, it means that the oldest costs are used for accounting purposes first, regardless of the actual materials flow.

### *Inventory costing methods illustrated*

Each of the more common inventory costing methods is illustrated for the Wentworth Company in Exhibits 3-9 to 3-14, assuming the following data for material A:

Jan. 1	Beginning inventory (Dec. 28 purchase) . . .	5 units @ \$1.00	\$ 5
Jan. 2	Purchase of material A . . . . .	70 units @ \$ .90	63
Jan. 5	Issue of material A . . . . .	20 units @ ?	?
Jan. 12	Purchase of material A . . . . .	40 units @ \$1.20	48
Jan. 25	Issue of material A . . . . .	10 units @ ?	?

#### *Summary:*

Total material A to account for . . . . .	115 units costing \$116
Accounted for as issues . . . . .	30 units costing ?
Accounted for as ending inventory . . . . .	85 units costing ?

The dollar amounts for the blanks with the question marks will vary under each of the costing methods. Since under each of these alternative methods the cost of the materials issued will differ, the cost of goods manufactured and sold and the income for the period will be affected. The balance sheet will also be affected, since the balance in the inventory account after calculating the cost of materials issued under one of these costing methods is the ending inventory cost.

#### **Fifo**

In the Fifo method shown in Exhibit 3-9, the cost of the first materials in (purchased) will be the costs assigned to the first materials out (issued).

It should be noted that if perpetual inventories are not maintained, or are maintained for quantities only, the periodic inventory method might be used in which the cost of the ending inventory is calculated first and the balance represents the cost of materials issued. Under Fifo, any materials on hand will be costed at the latest costs. The details of

*Exhibit 3-9*

**THE WENTWORTH COMPANY**  
Inventory Costing under Fifo  
Perpetual Inventory

Cost of materials issued:			
Jan. 5 —20 units	{ 5 units @ \$1.00.....	\$ 5.00	
	{ 15 units @ \$.90.....	13.50	
Jan. 25—10 units @ \$.90.....		<u>9.00</u>	\$ 27.50
Remainder in the ending inventory:			
45 units @ \$.90.....		\$40.50	
40 units @ \$1.20.....		<u>48.00</u>	88.50
Total costs accounted for.....			<u>\$116.00</u>

*Exhibit 3-10*

**THE WENTWORTH COMPANY**  
Inventory Costing under Fifo  
Periodic Inventory

Cost of ending inventory (the quantity may be obtained from a physical inventory count or from the perpetual inventory):			
85 units	{ 40 units @ \$1.20.....	\$48.00	
	{ 45 units @ \$.90.....	<u>40.50</u>	\$88.50
Total costs to account for.....		\$116.00	
Accounted for as ending inventory		<u>88.50</u>	
Cost of materials issued.....			<u>\$27.50</u>

the periodic inventory method of calculation under Fifo are shown in Exhibit 3-10.

**Lifo**

Under the Lifo method presented in Exhibit 3-11, the cost of the latest materials in (the latest purchases) will be the costs assigned to the first materials out (the earliest issues during the period). The perpetual inventory system with Lifo is assumed in Exhibit 3-11.

The Lifo data in Exhibit 3-11 assume the use of a perpetual inventory system in which requisitions are costed continuously at the latest available purchase cost as materials are issued. Somewhat different results may be obtained if the inventory is costed at the close of the period. To illustrate this point, assume that the periodic inventory system is used as shown in Exhibit 3-12 in which the inventory is costed monthly, rather than continuously, day to day, as under the perpetual inventory method.

Closely related to the Lifo method is a method, which has been suggested by some businessmen and accountants, that would cost the requisitions of materials at the market quotation at the time of issue—even

*Exhibit 3-11*

**THE WENTWORTH COMPANY**  
Inventory Costing under Lifo  
Perpetual Inventory

Cost of materials issued:			
Jan. 5 —20 units @ \$.90.....	\$18		
Jan. 25—10 units @ \$1.20.....	12	\$ 30	
Remainder in the ending inventory:			
5 units @ \$1.00.....	\$ 5		
50 units @ \$.90.....	45		
30 units @ \$1.20.....	36		86
Total costs accounted for.....			<u>\$116</u>

*Exhibit 3-12*

**THE WENTWORTH COMPANY**  
Inventory Costing under Lifo  
Periodic Inventory

Cost of ending inventory:			
5 units @ \$1.00.....	\$ 5		
70 units @ \$.90.....	63		
10 units @ \$1.20.....	12	\$ 80	
Remainder—cost of materials issued:			
30 units @ \$1.20.....			36
Total costs accounted for.....			<u>\$116</u>

though no purchase has actually been made at that cost. The use of this market replacement cost in the Lifo costing method has not been approved for income determination purposes by Federal income tax authorities or by professional accounting societies. It may, nevertheless, be useful for internal management purposes.

### Dollar-value Lifo

The Lifo method described in the preceding section is based on specific identification of units. In pricing ending inventories under this method, any increase over the opening inventory is priced at the earliest costs incurred during the year. The closing inventory may be viewed as consisting of two lumps of costs: a base stock carried over from the prior period and additional costs incurred this period.

In industries where the raw materials inventory consists of relatively few items, Lifo based on specific identification may be practical. However, in companies which utilize many raw materials, specific identification frequently is impractical. Because of the potential tax benefits under Lifo, managements of such companies for several years prior to 1961 attempted to obtain Treasury Department approval for reporting inventories on a dollar-value basis rather than a specific unit Lifo basis. In 1961, such permission was granted by the Internal Revenue Service.



Under the dollar-value Lifo method, it is necessary to separate the inventory into pools. These pools may be classified in the following ways:

1. Natural business unit, i.e., according to economic activity
2. Cost component, i.e., materials, labor, and overhead
3. Financial statement classification, i.e., raw materials, work in process, and finished goods

Under the dollar-value Lifo method, the ending inventory is costed twice; at the base year cost and at the current cost. The base year is the year in which Lifo was adopted. The difference between the ending and beginning inventory, at base year cost, represents the increase (or decrease) attributable to the present year. This is then converted back to current cost by application of a price index. The price index is derived by relating the closing inventory at current cost to the closing inventory at base year cost.

In practice there are several different variations in the calculation of closing inventories under the dollar-value Lifo method. One commonly used procedure is illustrated in Exhibit 3-13. As indicated, the ending inventory is computed at both base year and current cost, and the relationship between these two figures results in a cumulative price index of 120 percent. The inventory increase is converted into current cost through the application of this index to the increase in inventory at base year cost. This inventory increase at current cost is then added to the reported opening inventory, resulting in the closing inventory to be reported under the dollar-value Lifo method.

In Exhibit 3-13, the increase in inventory at base year cost was con-

*Exhibit 3-13*

**THE WENTWORTH COMPANY**  
Illustration of the Dollar-value Lifo Method

Item	Units in ending inventory	Unit cost		Ending inventory		Price index
		Current year	Base year	At current cost	At base year cost	
X	1,000	\$ .60	\$ .50	\$ 600	\$ 500	120%
Y	2,000	1.20	1.00	2,400	2,000	
				\$3,000	\$2,500	

Less: Beginning inventory at base year cost.....	\$2,000
Inventory addition at base year cost.....	\$ 500
Price index.....	$\times 1.2$
Increase in inventory at current year cost.....	\$ 600
Add: Beginning inventory as reported on books and for tax purposes.....	\$2,100
Cost of ending inventory as reported under dollar-value Lifo method.....	\$2,700



verted into current cost by means of a price index. Although it would seem that under the Lifo method, current cost should represent the earliest cost incurred during the year, the Internal Revenue Service actually permits current cost to be either (1) earliest cost incurred during the year, (2) average cost incurred, or (3) the most recent cost incurred.

Apart from the advantage of not having to specifically identify units, under the dollar-value Lifo method it is not necessary to replace specific units which have been depleted in order to maintain a Lifo position. Under the specific-identification method, failure to make such replacement results in a matching of base year costs with current revenue, which in the advent of rising prices produces high income and tax. This does not occur under the dollar-value Lifo method, as long as the total dollar value of the inventory pool remains intact, regardless of the actual depletion of specific items.

### Moving-average cost

Under the moving-average method of costing materials requisitions as portrayed in Exhibit 3-14, a new average unit cost is determined after each purchase. Subsequent materials issued are then costed at this

Exhibit 3-14

THE WENTWORTH COMPANY			
Inventory Costing under Moving-average Method of Costing			
Cost of materials issued:			
Jan. 5—20 units @ \$.9067			\$ 18.13
5 units costing	\$ 5.00		
70 units costing	63.00		
75	\$68.00		
(\$68.00 ÷ 75 units = \$.9067)			
Jan. 25—10 units @ \$1.0302			10.30
75 units costing	\$68.00		
-20 units costing	18.13		
55	49.87		
+40 units costing	48.00		
95	\$97.87		
(\$97.87 ÷ 95 units = \$1.0302)			
Total cost of materials issued			\$ 28.43
Remainder in the ending inventory:			
95 units costing	\$97.87		
-10 units costing	10.30		
85	\$87.57		87.57
(\$87.57 ÷ 85 = \$1.0302, which is the unit cost to be used for the next issues of materials)			
Total costs accounted for			<u>\$116.00</u>

average unit cost. Since the average costs are available at any time, this method is easily adapted to a perpetual inventory system.

### End-of-month average cost (or weighted-average cost)

Under the end-of-month average cost method, the materials issued during a month are costed at the weighted-average unit cost (total dollars divided by total units) as of the end of the previous month. Since the weighted-average unit costs at the end of the previous month are available during the current period for costing requisitions, this method may be used with either a perpetual or a periodic inventory system. Under a periodic system, the average cost used may be the average at the end of the *current* month. End-of-month average cost is illustrated in Exhibit 3-15.

### Standard cost

Fifo, Lifo, and average cost methods of costing materials issued are often cumbersome to work with in the subsidiary records for materials under a perpetual inventory system. The average cost methods involve a certain amount of arithmetic calculation, and the layers of inventory which may develop under Fifo and Lifo may become awkward to work with. For this, and other reasons, a standard cost per unit may be used in accounting for individual items in the materials inventory. Standard costs are discussed in a later chapter. It is sufficient here to indicate that standard unit cost for materials may be a type of normal or average unit cost.

### Base stock

The base stock method of costing inventory is rarely found, but it is similar to Lifo in effect. Under this method, a certain constant quantity, or base stock, of materials is assumed to be necessary to keep the concern going. This base is costed at the prevailing cost when the firm began or when the base stock method was adopted. Any additional layers of materials in the ending inventory beyond the units in the base may be

### Exhibit 3-15

#### THE WENTWORTH COMPANY Inventory Costing Using End-of-month Average Cost Method

Cost of materials issued:

Jan. 5 and 25—30 units @ \$1..... \$ 30

Remainder in the ending inventory:

85 units..... 86\*  
\$116

\*  $\$116.00 - \$30$ . The new unit cost for use in the following month is  $\$86 \div 85$  units, or \$1.012.

costed on the basis of first-in, first-out; moving average, etc. The Internal Revenue Service does not permit the use of the base stock method for Federal income tax purposes.

### *Management implications of inventory costing methods*

Inventory costing methods are of interest to management because they determine the amount of the firm's investment in inventory and because they influence the amount of a firm's reported income.

Fifo has been a popular inventory costing method for some time, since under this method the flow of costs corresponds with the flow of materials under the customary business practice of using the oldest inventory items first. Largely because of income tax considerations and rising price levels, however, Lifo has become increasingly popular in more recent years.

#### **Illustrations of the effect of inventory costing on income**

The Fifo method and the Lifo method have been chosen for purposes of illustrating and contrasting the effect of inventory costing methods upon income. In the Gordon Company illustrations below, only the raw materials element of the cost of goods manufactured and sold is considered, together with the sales price of the product manufactured and sold, in demonstrating the effect of Fifo and Lifo on profit margins.

#### **Period 1**

The following data are assumed for period 1:

#### **Materials Inventory:**

Jan. 1	Balance (Dec. 28 purchase).....	1 unit @ \$3.00
Jan. 10	Purchase.....	1 unit @ \$3.30
Jan. 12	Issue.....	1 unit
Jan. 31	Balance.....	1 unit

Assuming that the January 12 issue was sent into production and that the production was sold on January 20 for \$8, the effect of the two inventory costing methods on reported income is shown in Exhibit 3-16.

Under Fifo, the increase in materials cost due to a rising acquisition price amounting to 30 cents is reflected as an increase in the ending inventory. Under Lifo, it is reflected as an increase in cost of goods manufactured and sold, and hence as a decrease in profit margin.

Proponents of Lifo argue that Lifo gives a more realistic income figure. It is suggested by some accountants and businessmen that the income which can be disposed of (dividends, labor increases, growth, etc.)

*Exhibit 3-16*

**THE GORDON COMPANY**  
**Effect of Inventory Costing on Income**  
**Period 1**

<i>Method</i>	<i>Charge to cost of goods sold</i>	<i>Ending inventory</i>	<i>Sales revenue</i>	<i>Profit margin on materials</i>
Fifo.....	\$3.00	\$3.30	\$8.00	\$5.00
Lifo.....	\$3.30	3.00	8.00	4.70

at the end of period 1 amounts to \$4.70 because, in order to stay in business, it will cost \$3.30 rather than \$3 to replace the unit used. If \$5 of the \$8 sales price were spent (as a dividend, for example), the firm would have only \$3 with which to purchase the replacement unit costing \$3.30. The 30 cents difference between the Fifo result and the Lifo result is alleged to be a "paper profit" which has not truly been realized and thus should not be recognized as income.

It is argued, then, that in times of rising prices and costs, if the firm continues in business, Lifo gives a more realistic income figure for decision making, taxation, etc. On the other hand, under Lifo, the ending inventory is costed at an "old" (and lower) cost. Under Fifo, the inventory is costed more nearly at current costs. Working capital (current assets minus current liabilities) is stated more nearly in current dollars under Fifo than under Lifo.

**Period 2**

The following data are assumed for period 2:

*Materials Inventory:*

Feb. 1	Balance.....	1 unit @ \$3.30 (Fifo) or \$3.00 (Lifo)
Feb. 10	Purchase.....	1 unit @ \$3.80
Feb. 12	Issue.....	1 unit
Feb. 28	Balance.....	1 unit

In Exhibit 3-17, it is assumed that the February 12 issue was sent into production and that the production was sold on February 20 for the higher price of \$9.

With the sales price increase to \$9 and the increase in the purchase cost of materials to \$3.80, proponents of Lifo maintain that Lifo results in a better "matching" of current dollars of revenue and cost. Thus, the

*Exhibit 3-17*

**THE GORDON COMPANY**  
**Effect of Inventory Costing on Income**  
**Period 2**

<i>Method</i>	<i>Charge to cost of goods sold</i>	<i>Ending inventory</i>	<i>Sales revenue</i>	<i>Profit margin on materials</i>	<i>Cumulative profit</i>
Fifo.....	\$3.30	\$3.80	\$9.00	\$5.70	\$10.70
Lifo.....	3.80	3.00	9.00	5.20	9.90

new selling price of \$9 is matched against the new purchase cost of \$3.80 rather than the old purchase cost of \$3.30 as under Fifo. However, the ending inventory under Lifo is not costed in current dollars, but rather in old dollars, which will become older and more out of date as price levels continue to rise. The Fifo method produces an ending inventory more nearly in terms of current dollars.

It is apparent from the cumulative profit margin figures in Exhibit 3-17 that if purchase costs continue to rise and never fall below the level of period 1, total income over time under Lifo will be less than under Fifo. Only upon dissolution of the firm will the two methods give identical results in terms of total income over time.

### Smoothing of income

Because under conditions of changing prices, either upward or downward, the Lifo method tends to match current dollars of inventory costs with current revenues, there tends to be less fluctuation in reported income from period to period.

Although the arbitrary leveling or smoothing of income has traditionally been unacceptable to accountants, the use of acceptable accounting techniques which, as an incidental matter, level out, or smooth out, income from period to period may have merit. To the extent that business, investment, and other decisions are based upon the income figure, an erratic and fluctuating reported income may contribute to instability in the economic activities of a society. A smoothing of the costs may be more useful in management control and performance measurement, especially when the production function has no control over the timing of materials purchases.

### Changing price levels and inventory costing methods

During inflationary periods, which in the United States have been the most frequent experience, there typically is agitation among businessmen



and accountants to adopt accounting concepts which might aid management in dealing with the intensified pressures of government for income taxes, employees for wages, owners for dividends, and customers for lower product prices. The lower income resulting from Lifo compared with Fifo in an inflationary period means a lower income tax base, a higher ratio of employees' wages to owners' profits, lower reported income to owners, and a lower ratio of selling price to cost.

Funds for replacing inventories with more costly items might be made available through a conservation of those funds used to pay taxes, wages, or dividends, or by increasing funds from sales to customers. The use of Lifo cost in pricing decisions may tend to pass on the inflationary costs of materials to customers, when selling prices are sensitive to production costs.

Rising costs and prices have been assumed in most of the discussion above. In periods of falling prices and costs, the effect of Fifo and Lifo inventory costing methods on income and on inventory balances is opposite to that under rising prices. Under Fifo, when materials purchase costs decline, reported income amounts tend to be less than under Lifo. As a consequence, during periods of declining prices, Fifo typically gains more advocates. Fifo inventory balances in inflationary periods are thought to be inflated. Lifo inventory balances in deflationary periods are thought to be inflated.

### Lower of cost or market

The inventory costing methods discussed in the preceding pages of this chapter are cost methods. Some inventories, such as gold and farm livestock, are traditionally carried at market value for certain purposes, that is, at a "selling market" value. Lifo and replacement cost methods may also be viewed as market methods, but in this case "market" is defined as "buying market."

An additional method for assigning a monetary amount to inventories is the LCM method, meaning lower of cost or market. Under this method, the inventory, whether materials, work in process, or finished goods, is assigned the lower figure of cost or market. Market may be lower than cost when one of the following is true:

1. Price levels are declining, as in a depressed period.
2. Inventories are becoming obsolete because of technological or style changes.

LCM tends to provide a lower balance sheet inventory amount than other methods. For this reason, it usually has the support of short-term creditors. On the income statement, which tends to be of more interest to present and potential stockholder investors, long-term creditors, income tax authorities, and rate regulatory agencies, LCM may recognize inventory losses before the goods are sold. Thus, at any given time, LCM may show a lower income than might result under a cost method.

LCM emphasizes each time period rather than the ultimate consequences assumed under the continuity of operations or going concern concept. When prices fluctuate, LCM switches period by period from cost to market and vice versa. Because of this, it has been described as inconsistent. Since this method anticipates losses but not gains, LCM has also been viewed as a conservative method. The lower of Lifo cost or market has not had great acceptance.

It should be recognized that price changes for finished goods eventually may be reversed. Also, changes in the materials market price may be offset by changes in other production costs. These possibilities should be taken into consideration in arriving at a management policy for inventory valuation.

### *Problems and cases*

- 3-1 *Materials control.* What are the objectives of materials control? What is the role of a perpetual inventory system in materials control? Under what circumstances may a formal requisitioning system for materials be unnecessary?
- 3-2 *Purchasing function.* What are the responsibilities of the purchasing department in materials control?
- 3-3 *Audit of invoices.* Distinguish between the preaudit and the postaudit of invoices. What are the advantages and disadvantages of each method?
- 3-4 *Purchase discounts.* Describe two methods of accounting for purchase discounts. Which method do you regard as preferable?
- 3-5 *Inventory size.* What is the theoretically correct method for determining the optimum size of inventories?
- 3-6 *Inventory carrying costs.* What costs are included in the cost of carrying inventories?
- 3-7 *Perpetual and periodic inventory systems.* Distinguish between a perpetual and periodic inventory system.
- 3-8 *Direct and indirect materials.* Indicate how each of the following items might be classified as either direct or indirect materials, depending on the manufacturing circumstances:
- |       |             |
|-------|-------------|
| Paint | Glue        |
| Wire  | Hardware    |
| Paper | Light bulbs |
- 3-9 *Inventory costing methods.* Complete the following blank spaces.
1. Under \_\_\_\_\_, issues of materials during a period of time are costed at the latest purchase cost.
  2. Working capital is stated more nearly in current dollars under \_\_\_\_\_ than under \_\_\_\_\_.

3. LCM tends to provide a \_\_\_\_\_ balance sheet inventory amount than other methods.
4. Under \_\_\_\_\_, when materials purchase costs decline, reported income tends to be less than under \_\_\_\_\_.
5. In periods of rising prices, \_\_\_\_\_ gives more realistic figures for decision making than \_\_\_\_\_.
6. Under the \_\_\_\_\_ method, a new unit cost is determined after each purchase.
7. Under the \_\_\_\_\_ cost method, the materials issued during a month are costed at the weighted-average unit cost as of the end of the prior month.

3-10

*Journal entries for materials.* The Denver plant of the Sun-Pak Company maintains a factory ledger consisting of Stores (raw materials and supplies), Work in Process, and related accounts. All purchases are paid for by the Omaha general office. The following transactions occurred during a particular month. Record all journal entries to be posted in the factory ledger of the Denver plant.

1. Ordered materials and supplies amounting to \$40,000.
2. Received materials and supplies ordered amounting to \$38,000.
3. Returned materials and supplies to vendors in the amount of \$1,000.
4. Paid \$35,000 of suppliers' invoices.
5. Issued raw materials to producing departments in the amount of \$26,000.
6. Issued supplies to producing departments in the amount of \$2,000 and to the General Plant service department in the amount of \$1,000.
7. Spoiled materials costing \$500 with a salable value of \$150 is returned to stores by producing departments. Spoiled materials are kept in a special part of the storeroom and are charged to a Spoilage Inventory account at estimated sales value.
8. A physical count of the storeroom indicated that the actual inventory was \$250 less than the balance in the Stores account.

3-11

*Effect of inventory costing methods on income and inventories; maintenance of Lifo position* (constant selling prices, rising materials purchase cost). The Ruppenthal Company utilizes material M in the production of finished goods G. One unit of M is required for each unit of G. The \$10 unit selling price of G remains unchanged during the quarterly time period. There are no work-in-process inventories. Using the data given, and assuming perpetual inventories, calculate gross profit and inventory amounts for each of the 3 months under each of the following costing methods:

1. Fifo
2. Specific unit Lifo (using the latest purchase costs as of the end of the preceding month to cost requisitions)

	Jan.	Feb.	Mar.
Sales.....	\$900,000	\$1,000,000	\$800,000
Purchases (Dec., 90,000 units @ \$6 = \$540,000)	120,000 units @ \$7 = \$840,000	70,000 units @ \$8 = \$560,000	30,000 units @ \$8 = \$240,000

After making the calculations under Fifo and Lifo, discuss these questions:

1. Why is there no difference either in January or in February in the gross profit and inventory amounts under the two costing methods?
2. Assuming that Lifo were used for income tax purposes as well as for general financial accounting reports, what is the extent of the Lifo advantage in March? How might the firm lose its Lifo position? What factors are within the control of management to prevent the loss of the Lifo advantage?

**3-12** *Effect of inventory costing methods on income and inventories* (rising selling prices, rising materials purchase cost). The Lee Company produces Zocho out of Zoe, using one unit of the raw material for one unit of the finished product. Because of the short processing time, there are assumed to be no work-in-process inventories at any time. During a quarterly period, an identical volume of Zocho is sold in each month (inelastic demand). Using the data given, and assuming perpetual inventories, calculate gross profit and inventory amounts for each of the 3 months under each of the following costing methods:

1. Fifo
2. Specific unit Lifo (requisitions are costed at the end of each month, using the latest available purchase costs, including those incurred during the current month)

	<i>Apr.</i>	<i>May</i>	<i>June</i>
Sales.....	\$500,000 (50,000 units @ \$10)	\$600,000 (50,000 units @ \$12)	\$720,000 (50,000 units @ \$14.40)
Purchases (Dec. 31 inventory, 20,000 units @ \$5 = \$100,000)	120,000 units @ \$6 = \$720,000	70,000 units @ \$7.20 = \$504,000	30,000 units @ \$8.64 = \$259,200

After making the calculations under Fifo and Lifo, discuss these points:

1. By what percent did the unit sales price increase in each month? By what percent did the unit purchase cost increase in each month?
2. Under Lifo, by what percent was May gross profit larger than April gross profit? Why did the June gross profit not exceed the May gross profit by this same percentage under Lifo?
3. Which inventory costing method results in the most erratic profit in this case? Explain why the other method tends to "smooth out" income over time in this case.

**3-13** *Effect of inventory costing methods on income and inventories* (falling selling prices, falling materials purchase cost). The Davis Company produces product X out of material Y, using one unit of the raw material for one unit of the finished product. Because of the short processing time, there are assumed to be no work-in-process inventories at any time. During a quarterly period, an identical volume of X is sold in each month (inelastic demand). Using the data given, and assuming perpetual inventories, calculate gross profit and inventory amounts for each of the three months under each of the following costing methods:



1. *Fifo*
2. *Specific unit Lifo* (requisitions are costed at the end of each month, using the latest purchase costs, including those incurred during the current month)

	July	Aug.	Sept.
Sales.....	\$720,000 (50,000 units @ \$14.40)	\$600,000 (50,000 units @ \$12)	\$500,000 (50,000 units @ \$10)
Purchases (June, 70,000 units @ \$8.64 = \$604,800)	30,000 units @ \$8.64 = \$259,200	70,000 units @ \$7.20 = \$504,000	120,000 units @ \$6 = \$720,000

After making the calculations under *Fifo* and *Lifo*, determine what factors should be considered in evaluating the results of the two methods in August and September.

- 3-14 *Dollar-value Lifo method.* From the data presented below, calculate the closing inventory to be reported under the dollar-value *Lifo* method in 1963 and 1964.

1963 opening inventory: as reported \$1,350; at base year cost \$1,200

1963 closing inventory				1964 closing inventory	
Item	Units	Base year cost per unit	Current cost per unit	Units	Current cost per unit
X	100	\$1	\$1.10	80	\$1.10
Y	200	2	2.40	150	2.20
Z	300	3	3.20	400	3.10

- 3-15 *Normalizing materials related costs.* The Brown Company includes normal transportation, purchasing, receiving, and inspection costs as an element of materials cost for product costing purposes. The normal rate is based upon past experience and is revised annually. The normal cost of these materials-handling functions is added to the basic invoice cost of materials (net of cash discounts) at the time materials are received. The company has developed a single normal rate to include the cost of all the materials-handling functions, recognizing that some accuracy is sacrificed because of averaging.

As the transportation, purchasing, receiving, and inspection costs are incurred, they are collected by function for control purposes in accounts named Transportation Costs, Purchasing Costs, Receiving Costs, and Inspection Costs. Any amounts of these incurred functional costs not added to the basic materials cost as of the end of the year are added to cost of goods sold for the year.

1. Assuming that the normal cost rate is based solely upon functional costs incurred in the prior year as given below and that materials invoice cost is the base for the rate, calculate the rate to be used in the coming year.



## Prior Year's Costs

Materials invoice cost.....	\$200,000
Transportation costs.....	18,000
Purchasing costs.....	12,000
Receiving costs.....	9,000
Inspection costs.....	6,000

- Evaluate the costing method employed for product costing purposes.
- Assuming the actual functional costs in the current year given below, indicate which factors might account for a variation of the current year's functional costs from those of the prior year:

Materials invoice cost.....	\$180,000
Transportation costs.....	16,000
Purchasing costs.....	13,000
Receiving costs.....	7,000
Inspection costs.....	8,000

- What balance to be closed to Cost of Goods Sold would remain in the combined functional cost accounts at the end of the current year, assuming the data in (3)?
- Indicate by journal entries or T accounts the flow of costs through the accounts during the current year.
- Assuming that 80 percent of the materials purchased was used in production, which was then all completed and sold, what additional entries should be made? (Ignore any beginning inventories.) What is the amount of the Ending Materials Inventory?

## 3-16

*Effect of different inventory costing methods.* The Saunders Corporation uses raw material A in a manufacturing process. Information describing balances on hand, purchases, and requisitions of material A is given in the following table. You are to choose the best answer to each question, based on this information.

Date	Quantities			Dollars			
	Received	Issued	Balance	Unit cost	Received	Issued	Balance
Jan. 1.....			100	\$1.50			\$150
Jan. 24.....	300		400	1.56	\$468		
Feb. 8.....		80	320				
Mar. 16.....		140	180				
June 11.....	150		330	1.60	240		
Aug. 18.....		130	200				
Sept. 6.....		110	90				
Oct. 15.....	150		240	1.70	255		
Dec. 29.....		140	100				

1. If a perpetual inventory record of material A is operated on an Fifo basis, it will show a closing inventory of:
  - a. \$150
  - b. \$152
  - c. \$159
  - d. \$162
  - e. \$170
  - f. Answer not given
2. If a perpetual inventory record of material A is operated on an Lifo basis and issues are costed at time of issue, it will show a closing inventory of:
  - a. \$150
  - b. \$152
  - c. \$156
  - d. \$160
  - e. \$170
  - f. Answer not given
3. If a perpetual inventory record of material A is operated on a moving-average basis, it will show a closing inventory which is:
  - a. Lower than on the Lifo basis
  - b. Lower than on the Fifo basis
  - c. Higher than on the Fifo basis
  - d. Answer not given
4. Assume that no perpetual inventory is maintained for material A and that quantities are obtained by an annual physical count. The accounting records show information as to purchases, but not as to issues. On this assumption, the closing inventory on a Fifo basis will be:
  - a. \$150
  - b. \$156
  - c. \$159
  - d. \$160
  - e. \$170
  - f. Answer not given
5. Assume that no perpetual inventory is maintained for material A and that quantities are obtained by an annual physical count. The accounting records show information as to purchases, but not as to issues. On this assumption, the closing inventory on an Lifo basis will be:
  - a. \$150
  - b. \$156
  - c. \$159
  - d. \$160
  - e. \$170
  - f. Answer not given

(AICPA)

**3-17** *Effect of inventory costing methods over time.* The Berg Corporation began business on January 1, 1964. Information about its inventories under different valuation methods is shown below. Using this information, you are to choose the phrase which best answers each of the following questions.

	Inventory		Market	Lower of cost or market
	Lifo cost	Fifo cost		
Dec. 31, 1964.....	\$10,200	\$10,000	\$ 9,600	\$ 8,900
Dec. 31, 1965.....	9,100	9,000	8,800	8,500
Dec. 31, 1966.....	10,300	11,000	12,000	10,900

- The inventory basis which would show the highest net income for 1964 is:
  - Lifo cost
  - Fifo cost
  - Market
  - Lower of Cost or Market
- The inventory basis which would show the highest net income for 1965 is:
  - Lifo cost
  - Fifo cost
  - Market
  - Lower of Cost or Market
- The inventory basis which would show the lowest net income for the 3 years combined is:
  - Lifo cost
  - Fifo cost
  - Market
  - Lower of Cost or Market
- For the year 1965, how much higher or lower would profits be on the Fifo cost basis than on the Lower of Cost or Market basis?
  - \$400 higher
  - \$400 lower
  - \$600 higher
  - \$600 lower
  - \$1,000 higher
  - \$1,000 lower
  - \$1,400 higher
  - \$1,400 lower
- On the basis of the information given, it appears that the movement of purchase prices for the items in the inventory was:
  - Up in 1964 and down in 1966
  - Up in both 1964 and 1966
  - Down in 1964 and up in 1966
  - Down in both 1964 and 1966

(AICPA)

## 3-18

*Valuation of inventory of exchanged property.* The Big Essex Agency sells new and used cars and has a service department. On April 30, 1966, the used-car inventory consisted of four cars.

	Used-car number			
	1	2	3	4
Allowed on trade-in.....	\$1,700	\$2,400	\$1,000	\$1,400
Overallowance*	300	300	200	200
Service department charges for work on car†.....	60	-0-	40	160
National Auto Dealers Association estimate of market value (at retail):				
At time of trade-in.....	1,600	2,200	875	1,200
At Apr. 30, 1966.....	1,550	2,200	850	1,150
Probable sale price if sold during May, 1966‡.....	1,600	2,150	825	1,300

\* During the year, new cars were being sold at less than list where no trade-in was involved. The amounts in this line represent the discount that would have been allowed on the new car sold had that new car been sold for cash with no trade-in.

† The service department makes necessary repairs on used cars taken in trades and bills the used-car department at cost plus a  $33\frac{1}{3}$  percent markup on cost. The amounts in this line are the bills from the service department.

‡ With the exception of cars 2 and 4, which are still on hand, the used cars were sold for cash during the first week of May, 1966, at the amounts shown on this line.

Discuss the various factors which should be considered in assigning a value to the inventory of used cars. Indicate the computations needed to arrive at an acceptable inventory value for each car as at April 30, 1966.

(AICPA)

3-19 *Optimum inventory size.* The Hamilton Bicycle and Carriage Company stocks a variety of parts, which are assembled into various finished products. The company's management has placed great emphasis on controlling the inventory investment by reduction of turnover rates. For example, it is estimated that approximately 1,000 units of part X-100 are used annually in products manufactured. Last year the average number of units in stock was approximately 125, resulting in a turnover of 8:1 (1,000/125). This year, because of management's emphasis on turnover, the average inventory on hand has been reduced to 63 units and turnover doubled to 16:1 (1,000/63).

1. Do you feel that management is correct in stressing greater inventory turnover as the basis of inventory control?
2. Are there any disadvantages to having a higher inventory turnover?
3. Assume that part X-100 costs \$4 per unit, that the average cost of placing and processing a purchase order is \$15, and that inventory carrying costs amount to 10 percent of the cost of the inventory. Prepare a schedule which will show the theoretically correct average inventory and the number of purchase orders to place, for the 1,000 units of X-100 required.

## **4. Labor Costs—Accounting and Control**

This chapter is concerned with the administration and control of labor services and accounting for labor costs. Primary emphasis is on factory labor costs. The control of nonfactory labor expenditures will be dealt with in later chapters.

Although the role of labor in the modern corporation has changed somewhat as a consequence of automation and union activities, nevertheless, labor expenditures generally represent a significant portion of the total costs incurred by a company in the production, marketing, and distribution of its products. It is important, therefore, for management to create an environment conducive to efficient labor performance, to establish adequate controls over labor activities, and to properly account for labor expenditures.

### **Classifying labor activities**

From the standpoint of both accounting and control, it is necessary initially to establish meaningful labor classifications. In a modern corporation, labor services often are classified in the following ways:

1. According to primary organization function. Three broad categories may be distinguished: factory, sales, and general administration. The distinction between factory and nonfactory labor is important. It will be recalled that factory labor costs are attached to products manufactured, whereas nonfactory labor is treated as an expense of the period.

2. According to departmental activity. Within these broad functional categories, labor is classified according to departments, e.g., factory—mixing, factory—cooking, factory—purchasing. Segregating labor costs by departments enhances the control over these costs. Department supervisors are held responsible for labor performance and costs incurred within their departments.

3. According to type of work. Within a department, labor may be classified according to the nature of the work performed, e.g., mixing—supervision, mixing—direct labor, mixing—material handlers. These work classifications often serve as the basis for establishing wage differentials.



Also, to the extent that standards of performance can be established, they are geared to the type of work performed.

4. According to the direct or indirect relationship to products manufactured. As indicated previously, factory labor which is directly engaged in the manufacturing of products is known as direct labor. Factory labor not directly engaged in the fabrication of products is called indirect labor. Direct labor is charged directly to Work in Process, whereas indirect labor becomes part of Factory Overhead. There are many kinds of indirect labor, e.g., supervision, building maintenance, receiving, cost accounting.

In regard to certain types of labor, the distinction between direct and indirect may depend on management definition. Inspectors and material handlers come into direct contact with the products manufactured, yet they commonly are treated as indirect laborers. The principal reason is that inspectors and material handlers work on a variety of products and it is difficult to identify these costs with particular products. In addition, they are not considered to contribute directly to the fabrication of products. On the other hand, in a job shop, setup labor which is not directly engaged in the manufacturing of products often may be treated as a direct-labor cost, since it can be identified with specific jobs.

The four methods used to classify labor, as related to the factory, are shown below, with examples:

<i>Classification</i>	<i>Example</i>
Primary function	Factory
Departmental activity	Mixing
Nature of Work	Mixers
	Supervisors
	Material handlers
Directness to products:	
Direct	Mixers
Indirect	Supervisors
	Inspectors
	Material handlers
	Timekeepers
	Clerical workers

### *Labor administration and cost control*

Factory labor is used to convert raw materials into finished goods. Labor is a service, which, unlike materials and supplies, cannot be stored and does not demonstrably become a part of the finished product. The functions involved in acquiring and administering labor services, therefore, are somewhat different from the acquisition, utilization, and disposition of materials.

Proper cost control over labor expenditures involves the following:

1. Satisfactory procedures for selecting, training, and assigning workers to jobs.

2. An adequate program of labor compensation, sanitary and healthy working conditions, and employee benefits, consistent with legal requirements and competition.

3. Methods for assuring efficient labor performance.

4. Controls to assure that only properly qualified workers are compensated and in accordance with services actually rendered.

The following business functions are most directly involved in labor administration and control:

1. Personnel and labor relations
2. Timekeeping
3. Payroll accounting

4. Cost accounting
5. Motion and time study

### **Personnel and labor relations**

The personnel and labor relations function is concerned with the establishment and administration of policies and procedures relating to hiring, classifying, training, and conditions of employment of workers. In a small firm, many of these activities may be delegated directly to departmental supervisors. In a large concern, the following responsibilities may be included in the personnel and labor relations function:

**1. Employment and separation:**

- a. Recruiting
- b. Employment interviews
- c. Checking references
- d. Testing and selection procedures
- e. Bonding employees
- f. Employee placement
- g. Exit interviews

**2. Training:**

- a. Maintenance of vestibule school
- b. On-the-job training program
- c. Executive training
- d. Scholarships and other educational incentives

**3. Job classification:**

- a. Job analysis
- b. Job description
- c. Job classification
- d. Job transfers
- e. Merit rating
- f. Negotiation with unions

**4. Medical and safety:**

- a. Administration of company medical facilities
- b. First aid
- c. Employee medical examinations

- d. Sanitary conditions
- e. Safety standards
- f. Safety devices
- g. Safety education
- 5. Personnel relations:
  - a. Collective bargaining
  - b. Working conditions
  - c. Salary and wage administration
  - d. Vacation and bonus policies
  - e. Adjusting grievances
  - f. Employee suggestions
- 6. Employee benefits:
  - a. Pension plan
  - b. Hospitalization
  - c. Group insurance
  - d. Employee cafeteria
  - e. Recreation facilities
  - f. House organ

### Timekeeping

The timekeeping function maintains records relating to hours worked, nature of work assignments, and units produced. This information is used by the payroll department to determine earnings due to employees and by cost accounting in charging appropriate accounts, departments, and/or jobs.

The timekeeping function is an important part of a firm's system of internal control, since it provides assurance to the payroll department that the hours indicated on the clock cards were actually worked. It also provides the cost accounting department with explanations as to the causes of idle time or below-standard performance. These reasons for labor inefficiency may then be incorporated into reports to management.

The organizational status of the timekeeping function differs among firms. In some companies, timekeeping may report directly to the production manager or controller. In other companies, timekeeping may be included in cost accounting. In small companies, the timekeeping function may be performed by the workers themselves.

The two principle documents which come under the jurisdiction of the timekeeping function are the *clock card* (Fig. 4-1) and the *time ticket* (Fig. 4-2).

The clock card is a record of the attendance of employees. It discloses the number of regular and overtime hours worked during a week. Generally, workers are required to punch the clock card as they begin and terminate their work. At the end of the week, the clock cards are sent to the payroll department, where they are summarized and used as the basis for calculating the gross pay of each hourly employee.

The time ticket indicates how an employee spent the time as between

Kendall Manufacturing Co.								
WEEKLY CLOCK CARD								
Employee <u>T. Collins</u>					Dept. <u>Assembly</u>			
Clock No. <u>13582</u>					Week <u>3/5/64</u>			
Shift <u>1</u>								
Day	Regular				Overtime		Hours	
	In	Out	In	Out	In	Out	Reg.	O.T.
Mon.	8:32	12:01	1:01	5:34			8	
Tues.	8:15	12:05	1:00	5:31			8	
Wed.	8:20	12:00	12:30	5:00			8	
Thurs.								
Fri.	8:30	12:30	1:30	5:30	6:30	8:30	8	2
Sat.								
Sun.								
Total							32	2

Fig. 4-1 Clock card.

Kendall Manufacturing Co.				
TIME TICKET				
Employee <u>S.R. Jones</u>			Nature of work <u>Molding</u>	
Shift <u>1</u>			Units completed <u>5</u>	
Job or a/c <u>109</u>			Date <u>3/5/64</u>	
Time Started	Time Stopped	Hours Worked	Rate	Amount
8:30	11:30	3	2.00	6.00
Approved by <u>T.F.M.</u>				

Fig. 4-2 Time ticket.





Employees most commonly are paid by checks, although in some cases agreement with the union may require cash payments. In medium- and large-sized firms, the preparation of check and entry in the employee's earning record and payroll journal occur simultaneously.

### Cost accounting

The cost accounting department, based on time tickets, distributes the total gross payroll to appropriate accounts and subsidiary ledger records.

#### Exhibit 4-1

Weekly Labor Cost Report  
Assembly Department  
Week Ended February 6, 1964

Period.....	This week		Last week	Year to date
Cost of units completed..	\$24,000		\$25,000	\$226,000
Labor costs	Total	Cost per dollar of production	Cost per dollar of production	Cost per dollar of production
Direct labor.....	\$ 8,000	\$ .333	\$ .339	\$ .338
Supervision.....	400	.167	.172	.170
Materials handling.....	400	.167	.169	.165
Inspection.....	300	.125	.125	.126
Idle time.....	700	.292	.290	.293
Overtime premium.....	500	.208	.210	.211
Setup.....	600	.250	.253	.252
Total.....	\$10,900	\$1.542	\$1.558	\$1.555

#### Exhibit 4-2

Daily Labor Efficiency Report  
Grinding Department  
January 10, 1964

	Actual	Standard	Variance	Efficiency, %
Direct-labor hours.....	160	145	15	90.6%
Reasons for unfavorable variance:				
Operator inefficiency.....			4	
Machine breakdowns.....			2	
No work.....			4	
Defective materials.....			2	
Bad specifications.....			3	
Total.....			15	

The cost accounting department also is responsible for preparing and issuing reports to factory management for purposes of labor cost control. Where labor standards have not been established, the report may contain a comparison of the labor cost per dollar of manufactured goods for the current period and for preceding periods, as shown in Exhibit 4-1. Where labor standards exist, a daily labor efficiency report similar to Exhibit 4-2 may be prepared.

### **Motion and time study**

Motion and time study activities normally are included in the industrial engineering function. Motion and time study engineers are responsible for establishing piece rates where an incentive system exists. This generally is accomplished in conjunction with union representatives. Motion and time study engineers also cooperate with the personnel department in establishing job descriptions. In the absence of an incentive system, labor standards may be established on the basis of time and motion studies. This function also is responsible for recommendations for improved methods of production.

### **Departmental supervision**

In the final analysis, the single most important influence in labor administration and control is the departmental supervisor. The departmental supervisor has the closest direct contact with employees. A departmental supervisor not only must be technically competent but also must know how to communicate so that satisfactory employee relations and high levels of efficiency will be maintained.

### **Controllability and variability of labor costs**

With the strengthening of the labor union movement, labor costs have become less controllable by management and less variable in nature. Wage rates and fringe benefits specified in union contracts are not controllable by lower levels of management. Indeed, it may be argued that they are not even controllable by top management in cases when management's bargaining power is weak and the labor union pressure is strong.

A management policy not to fire certain people or to stabilize operations and avoid large-scale hiring and firing "peaks" tends to make labor costs fixed rather than variable.

Thus, in many cases, because the wage rate is not controllable and the labor expenditure is, in effect, fixed, the opportunity for cost control resides in the area of labor performance or efficiency. Techniques such as standard costs and employee profit-sharing plans are aimed at motivating employees toward greater efficiency and more productive accomplishment.

## Accounting for labor costs

### Labor compensation plans

Labor may be compensated on the basis of the unit of time worked (hour, day, week, month, year), units of output produced, or a combination of the two. Executive, supervisory, clerical, and indirect factory salaries and wages tend to be based upon units of time without regard to output. Direct factory wages, on the other hand, are based frequently upon units of output in lieu of, or in addition to, time worked.

Individual and group incentive plans are used frequently as the basis of remuneration. The purpose of incentives in wage plans is to encourage and promote efficiency. Efficiency may be improved by increasing productive output without increasing input time, or by decreasing input time without decreasing productive output. Certain incentive plans enable the employee to share in the savings resulting from this increased efficiency.

A saving in labor input time also results in lower production cost per unit of product, because factory overhead—the bulk of which generally is fixed in total amount and does not change with changes in activity—can be spread over a greater number of units of output. The labor compensation plans discussed below are most applicable to direct factory labor.

Under the *straight piecework with a guaranteed hourly minimum plan*, the employee is paid a guaranteed hourly rate to produce a standard number of pieces or units of output. For production in excess of the standard number of pieces, the employee earns an additional amount per piece, calculated at the rate of the hourly wage rate divided by the standard number of pieces per hour.

A variant of this method is called the *100 percent premium or bonus plan*. Under this plan, the employee's actual hourly output (average for payroll period) is divided by standard output per hour, resulting in an efficiency factor or ratio, which is then multiplied by the employee's hourly wage rate to find the employee's earnings for the period.

The *Taylor differential piece rate plan* is a straight piece rate plan which merely uses one rate per piece for lower output rates per hour and another for higher output rates per hour.

The *Gantt task and bonus plan* allows the employee a bonus, calculated as a percent of the hourly pay which is guaranteed, when his output per hour reaches a certain standard.

Under the *Halsey premium plan*, the employee is guaranteed a minimum hourly wage and is paid an additional amount as a reward for the *effective production time saved* when compared with standard production time. For example, if the standard production per hour is 50 units, an employee producing 60 units per hour effectively saves one-fifth of an hour. This fraction is multiplied by the hourly rate or a fraction of it to determine the *additional earnings per hour*.

Graduated bonus plans such as the *Emerson efficiency plan* provide for a bonus scale, calculated as a percentage of the minimum guaranteed hourly wage rate, which is graduated to correspond with an efficiency factor scale. The efficiency factor is calculated as the average actual time taken to produce a unit divided by the standard time.

Under a *premium point plan*, such as the one named after Bedeaux, production is measured in "points" (such as "B's"), which is the measure of 1 minute's work. The employee earns, in addition to the minimum guaranteed hourly wage, a bonus for each point earned in excess of standard.

### **Payroll taxes and government reporting requirements**

Both the Federal government and state governments levy taxes which directly affect the employer and the employee. Certain of these taxes are borne by the employer, and certain of them are borne by the employee. For discussion here, the payroll taxes have been classified in four general categories:

1. F.I.C.A. (Federal Insurance Contribution Act), known also as O.A.S.I. (Old Age and Survivors' Insurance); F.O.A.B. (Federal Old Age Benefits); and S.S. (Social Security). As of January 1, 1963, employers must withhold 3% percent of the first \$4,800 of gross wages or salary of each *employee*. In addition, the *employer* must contribute a matching amount.

2. U.C. (Unemployment Compensation). This is a Federal act but, in effect, is a joint Federal and state arrangement in most states. Employers who come under the act must contribute to the Federal government an amount equal to 3 percent of the first \$3,000 of each employee's wages and salary. Most states have established state unemployment compensation laws which qualify them to receive 90 percent of this amount, which would otherwise all be payable to the Federal government. Thus, in those states, unemployment compensation borne by the *employer* amounts to 3 percent, of which 2.7 percent is remitted to the state and 0.3 percent to the Federal government. In some states a firm may reduce its rate by having a stable employment record. Some states also levy an unemployment compensation tax on the *employee*.

3. Withholding tax (Federal income tax withheld). Employers must withhold Federal income tax "at the source" on the earnings of employees. Rates vary among individual employees depending upon earnings and exemptions.

4. Workmen's compensation insurance. Some states have laws assessing *employers* for this insurance against losses caused by employment accidents and diseases. Premiums vary with risk classifications. Some states permit the employer to insure privately or self-insure against this risk.

The employer must file a quarterly return with the Internal Revenue Service for both the employee and employer share of F.I.C.A. and for Federal income tax withheld from employees. These taxes must be de-



posited monthly with a bank which has been designated as a government depository if they amount to more than \$100 per month. If they are less than \$100 per month, they are paid quarterly. At the end of the year, copies of withholding tax statements (Form W-2) are furnished to employees and also forwarded to the Internal Revenue Service. The Federal Unemployment Compensation tax must be paid annually. Reporting to states and the forwarding of payments to them for state unemployment compensation tax varies.

It should be emphasized that the following taxes are borne by the employer and therefore become a cost in addition to the contractual wage or salary:

Employer's share of F.I.C.A.

Unemployment compensation (state and Federal)

Workmen's compensation

The employee's taxes, which are deducted from payroll checks and do not become a cost to the employer, are as follows:

Employee's share of F.I.C.A.

Income tax withheld

Payroll taxes borne by the employer may be added to the respective types of labor costs such as direct factory labor, indirect factory labor, sales salaries, or general and administrative office salaries. Because of the complexity and accompanying clerical cost of doing this, it is more common to treat payroll taxes on both direct and indirect factory labor as factory overhead and those taxes on selling and administrative payrolls as selling and administrative expense.

### Accounting entries for labor

Let us assume that the Miller Corporation had the following payroll data for a particular week:

Direct labor		\$20,000.00
Indirect factory labor		9,000.00
Selling salaries		8,000.00
Administrative salaries		6,000.00
Unemployment compensation tax—state and Federal (3%):		
Factory	\$ 870.00	
Sales	240.00	
Administrative	180.00	1,290.00
Workmen's compensation tax—factory		500.00
F.I.C.A. tax (3½ %):		
Employer:		
Factory	\$ 1,051.25	
Sales	290.00	
Administrative	217.50	
Employee	1,558.75	3,117.50
Income tax withheld		8,200.00
Union dues deducted		220.00



The following entry would be recorded to reflect these costs and liabilities:

Work in Process.....	20,000.00	
Factory Overhead.....	11,421.25	
Selling Expense.....	8,530.00	
Administrative Expense.....	6,397.50	
Federal Unemployment Tax Payable.....		129.00
State Unemployment Tax Payable.....		1,161.00
F.I.C.A. Tax Payable.....		3,117.50
Workmen's Compensation Tax Payable.....		500.00
Income Taxes Withheld.....		8,200.00
Union Dues Payable.....		220.00
Accrued Payroll.....		33,021.25

Exhibit 4-3 shows how the same entry would be recorded if a separate factory ledger is maintained. Here, only the cost accounts are kept on the factory ledger. The payroll liabilities appear on the general ledger. The reciprocal account which ties the two ledgers together may be called Accrued Payroll, Payroll Clearing Account, General Ledger-Factory Ledger Account, or some other title deemed appropriate. In these illustrative payroll entries, the charge to Factory Overhead, Selling Expense, and Administrative Expense includes the gross pay plus the payroll taxes borne by the employer.

### Overtime premium and shift bonuses

In addition to the regular pay, overtime premiums must be paid by all firms engaged in interstate commerce (broadly interpreted) for hours worked in excess of 40 per week, under provisions of the Fair Labor

#### Exhibit 4-3

##### Payroll Entry—Split Ledger

###### Factory ledger:

Work in Process.....	20,000.00	
Factory Overhead.....	11,421.25	
Accrued Payroll (or Payroll Clearing, General Ledger).....		31,421.25

###### General ledger:

Accrued Payroll (or Payroll Clearing, Factory Ledger) ..	31,421.25	
Selling Expense.....	8,530.00	
Administrative Expense.....	6,397.50	
Federal Unemployment Tax Payable.....		129.00
State Unemployment Tax Payable.....		1,161.00
F.I.C.A. Tax Payable.....		3,117.50
Workmen's Compensation Tax Payable.....		500.00
Income Tax Withheld.....		8,200.00
Union Dues Payable.....		220.00
Wages or Vouchers Payable.....		33,021.25

Standards Act, commonly referred to as the Wage and Hour Law. The overtime premium is equal to one-half the regular rate. If, for example, an employee works 44 hours in a week at the regular rate of \$2.50, his gross earnings would be as follows:

Regular time.....	40 hr @ \$2.50	\$100
Overtime.....	4 hr @ \$2.50	10
Overtime premium.....	4 hr @ \$1.25	5
Total earnings.....		<u>\$115</u>

The proper accounting treatment of overtime premium depends on the reasons for the incurrence of overtime. Overtime premium may be added to direct labor and charged to the job or department which was responsible for the overtime. This may be justified if an order is taken at a time when the factory is operating at full capacity and the customer is willing to accept an additional charge for the overtime required.

A second method of handling the overtime premium is to consider it as an element of factory overhead. This is the most common treatment. In most situations, overtime cannot be identified with particular jobs but rather applies to all jobs. Another reason for charging the overtime premium to Factory Overhead is that it then appears on the monthly schedule of factory overhead and is brought to management's attention.

A third method of handling overtime premium is to exclude it entirely from the cost of products manufactured and treat it as a period expense. This treatment is warranted when overtime is caused by inefficiency or wasted regular time.

The accounting treatment of shift bonuses, e.g., night shifts, is similar to that for overtime premium. Most commonly, it is charged to Factory Overhead.

## Accounting for labor-related costs

### Vacation, holiday, and bonus pay

Many companies accrue vacation, holiday, and bonus payments throughout the year on the basis of budgetary estimates. If this is not done, the period during which these extra payments or lowered production occur is unduly penalized, resulting in unsatisfactory comparative data.

The accrual is based on estimates, as shown below for vacation pay:

	Factory direct labor	Factory indirect labor
Estimated annual cost.....	\$100,000	\$50,000
Estimated vacation pay.....	5,000	2,000
Vacation pay in percent of annual cost.....	5%	4%

Throughout the year as direct and indirect factory labor costs are incurred, the vacation pay is accrued and charged either to Work in Process or Factory Overhead, as shown below in an example of the factory payroll journal entry at the close of a particular week:

Work in Process.....	10,500	
Factory Overhead.....	5,200	
Payroll Accrued.....		15,000
Vacation Pay Accrued.....		700

The charge to Work in Process represents \$10,000 of direct labor plus 5 percent for vacation pay, and the charge to Factory Overhead \$5,000 of indirect labor plus 4 percent for vacation pay. According to this method, the 5 percent charge to Work in Process also is added to the direct labor charged to each job. An alternative treatment is to charge the accrued vacation pay on direct as well as indirect labor to Factory Overhead. This may produce somewhat less exact job costs but is simpler from a clerical standpoint. When vacation pay is distributed, the Vacation Pay Accrued account is debited and Cash is credited.

### Setup time

Often, a considerable amount of time and money may be required to start up production. These costs are referred to as *setup costs*. Setup occurs when a plant or process is being opened or reopened or when a new product is introduced. Setup costs include expenditures for designing and setting up machines and tools, training workers, and initial abnormal losses resulting from lack of experience. Setup costs are apt to be particularly important in a job shop, where the nature of each job is different.

Three different accounting methods for handling setup costs are found in practice:

1. Inclusion in direct labor. Since setup costs can be specifically identified with jobs, they are frequently treated as a direct-labor cost and charged directly to Work in Process and appropriate jobs. The principal advantage of this method is that it provides a more precise indication of the actual cost of jobs than if these costs were instead buried in factory overhead. Under this method, the journal entry would be as follows:

Work in Process.....	XXXX	
Various Accounts (Source of Setup)		XXXX

2. Inclusion in factory overhead. If setup costs are included in direct labor, it becomes difficult to compare the cost per unit for similar jobs. This takes place because the amount of setup costs may be spread over varying numbers of units, depending on the size of jobs. Accordingly, some accountants prefer to treat setup costs as an item of factory overhead to be assigned to all jobs on some basis of apportionment. Under this method the journal entry would be as follows:

Factory Overhead.....	XXXX	
Various Accounts (Source of Setup)		XXXX

3. A separate charge to Work in Process and jobs. Perhaps the most desirable treatment under most circumstances is to charge setup costs to Work in Process and jobs directly but as a separate and identifiable cost rather than as a part of direct labor. This procedure facilitates comparison between job and unit costs. The journal entry would be the same as under the first method, although setup would appear as a separate charge to Work in Process and jobs rather than being included with the direct labor.

### Pension costs

During recent years, pension plans have become common in American industry. Generally, a portion of the annual pension contribution is paid by both the employer and employee. In some plans, this annual contribution purchases an immediate retirement annuity which commences after a given age, e.g., sixty-five years. In other plans, if a worker leaves the employment of the company before the retirement date, he is entitled to his contribution plus interest at a stated rate. The specific contractual arrangement varies from company to company.

Accounting for pension plan costs is apt to be rather complicated in practice. It may be necessary to estimate the number of workers that will reach retirement age, their life expectancy, the cost of administering the plan, and interest earned on invested pension funds. Consideration also must be given to the provisions of the Internal Revenue Code. Estimating pension plan costs also may require projections of future wage trends and consideration of social security benefits. It is beyond the scope of this book to consider these and other ramifications of pension plan accounting.

Pension plan costs involve a problem of time period allocation. Ideally, these plan costs are incurred over the employment period of each employee and should be added to the labor cost or expense of each fiscal period during the employment period. This is difficult to do (1) where the pension plan is adopted subsequently to the firm's starting in business and (2) where employees are not eligible for this benefit until after a certain number of years of service.

In either of these situations, there is the problem of how to treat pension plan costs attributable to past periods of service. One method of dealing with the past service portion of these costs is to charge it to retained earnings. Alternatively, based on the "clean surplus" concept, it is often handled through the income statement either as a nonrecurring expense or as part of current fringe benefit costs.

Accounting for pension plan contributions may be illustrated by a simplified example. Assume that a company's pension plan requires equal contributions from both employer and employee of 5 percent of the gross



earnings. At the close of a particular week, Adams (direct labor) earned \$140 and Bates (indirect labor) earned \$100. The payroll journal entry, eliminating other payroll considerations, might be as follows:

Work in Process.....	140	
Factory Overhead.....	112	
Pension Payable.....		24
Payroll Accrued.....		228

It will be noted that the employer's share of the pension costs ( $.05 \times \$240$ ) is charged to Factory Overhead and the employee's share is deducted from his pay. An alternative treatment for the employer's pension cost is to charge the employer's share directly to Work in Process and appropriate jobs. Although this may result in somewhat more precise costing, particularly in a job-order system when overhead rates may be based on labor or machine hours, because of the additional clerical work involved it is more common to charge the employer's share of pension costs to Factory Overhead.

### Idle time

During the fabrication of products, lost time may occur for such reasons as temporary lack of work, bottlenecks, or machine breakdowns. Often this excess cost is merely included in the direct-labor cost and not accounted for separately. Better cost control is attained when idle time is charged to Factory Overhead and to a special account or accounts (by causes). At the close of the month, the amount of idle time then will appear on the schedule of factory overhead and come to the attention of management. Assuming that the latter method is used and that a worker earning \$2 an hour worked 40 hours during a particular week, of which 4 hours represented idle time, the following entry would be made:

Work in Process.....	72	
Factory Overhead (Idle Time).....	8	
Payroll Accrued.....		80

An alternative method for dealing with idle time is to treat such costs as period expenses rather than as a cost of the products manufactured. In effect this method regards idle time as a loss which is not properly inventoriable. Although this method is theoretically sound, it is not commonly used in practice.

### Fringe benefits and management decisions

Fringe benefits include a variety of labor-related costs including payroll taxes, pension costs, hospitalization, vacation and holiday pay, and insurance plan costs. Realistically, fringe benefits are a part of the cost of direct and indirect factory labor, salaries of salesmen, and salaries of general office and administrative personnel. They are often buried in factory overhead or charged off as selling and administrative expenses.



A simple illustration readily points out that the failure to recognize fringe benefits as labor costs can lead to erroneous management decisions. Assume, for example, that the Locke Company prepared a bid for the manufacture of 10,000 units of a product. The project would not require additional production facilities, and therefore overhead costs were ignored. None of the presently employed force would be available. The company treated fringe benefit costs, amounting to approximately 15 percent of labor cost, as a factory-overhead item.

The Locke Company estimated that sufficient labor could be hired at \$2.50 per hour to do the job in an estimated 10,000 man-hours. Material costs were estimated at \$1 per unit. The company felt that it would be satisfied with a 10 percent markup on the added costs. The following bid was submitted:

Materials	\$10,000
Labor	25,000
	<u>\$35,000</u>
Markup (10%)	3,500
Price quotation	<u>\$38,500</u>

Assume that the Locke Company received the order. Since no consideration was given to fringe benefit costs because they were classified as factory overhead, the company lost money on the project. The inclusion of fringe benefit costs in the analysis gives the following result:

Sales	\$38,500
Materials	\$10,000
Labor	25,000
Fringe benefits	<u>3,750</u>
Loss	<u>\$ 250</u>

Accounting for fringe benefit costs separately is important in many other management decisions, particularly in labor dispute negotiations.

## Problems and cases

- 4-1 *Functions involved in labor control.* Which functions in a company are most directly involved in the control of labor? Briefly describe the responsibilities of each of these functions in the control of labor.
- 4-2 *Labor classifications.* List four ways of classifying labor.
- 4-3 *Labor incentive system.* A company is considering a labor incentive system under which laborers will be paid 100 percent of the time saved. Since the firm does not participate in the savings from increased labor efficiency, what benefit does it derive from the plan?

- 4-4** *Calculation of employee base earnings.* The Allen Company guarantees its direct factory labor personnel a standard hourly rate of \$1.80 per hour for the production of 100 units of product P. For each additional unit per hour produced on the average each day, the employee earns 4 cents per unit.

1. Calculate the daily wages earned in these cases:

<i>Employee</i>	<i>Hours worked</i>	<i>Units produced</i>
A	7	720
B	8	740
C	8	810

2. Should the units produced by the more efficient employees be costed at a different rate from those produced by the less efficient employees?
3. Should the 4-cents premium earnings be treated differently for product costing purposes from the guaranteed hourly earnings?

- 4-5** *Miscellaneous aspects of labor accounting.* Complete the blank spaces in the statements which follow.

1. Two basic forms used in accounting for labor costs are the \_\_\_\_\_ and the \_\_\_\_\_.
2. Two payroll taxes imposed on the employer are \_\_\_\_\_ and \_\_\_\_\_.
3. An example of a labor cost which is direct to a department and indirect to product is \_\_\_\_\_.
4. When labor standards exist, the percentage labor efficiency is calculated by dividing \_\_\_\_\_ by \_\_\_\_\_.
5. Under the \_\_\_\_\_ plan, the employee's actual hourly output (average for the payroll period) is divided by standard output per hour, resulting in an efficiency factor or ratio which is then multiplied by the employee's hourly wage rate to find the employee's earnings for the period.
6. An example of a variable labor cost is \_\_\_\_\_, of a fixed labor cost is \_\_\_\_\_, and of a semivariable labor cost is \_\_\_\_\_.

- 4-6** *Calculation of employee base earnings.* The Bonini Company pays its direct factory employees a guaranteed minimum wage of \$2 per hour. In addition, a bonus is paid for effective production time saved multiplied by the \$2 rate.
1. What amount would be earned by each of the following employees:

<i>Employee</i>	<i>Hours worked</i>	<i>Standard hourly output</i>	<i>Actual output</i>
A	40	80 units	3,360 units
B	38	80 units	3,648 units
C	40	80 units	3,000 units

2. Should the units produced by the more efficient employees be costed at a different rate from those produced by the less efficient employees?
3. Should the bonus earnings be treated differently for product-costing purposes from the guaranteed wages? Should a loss be recognized on the production of the less efficient employees?

4-7 *Definition of production cost; interrelationship of labor and other production costs.* The management of the Young Company has proposed to the union to which its employees belong that a group bonus system be inaugurated in which a portion of "production cost savings" would be passed on to the employees. Production cost savings were defined as "the reduction of the unit cost of product below the average of the previous two-year period." Aside from the percentage of the savings to be passed on, indicate what factors should be considered by both the union and management in further defining production cost savings.

4-8 *Accounting for labor-related costs.* Describe alternative methods of accounting for each of the following labor-related costs for product-costing and income-determination purposes.

1. Pension plan costs
2. Vacation pay
3. "Paid holiday" pay
4. Employee health and welfare plan costs

4-9 *Labor cost data for management.* Briefly describe what labor cost and efficiency information might be useful to the management of a radio-manufacturing concern for planning and control purposes. Indicate how this information might be used.

4-10 *Labor-related costs and contract costs.* The cost of unemployment compensation taxes to an employer is sometimes reduced as a result of a "good" experience rating. A manufacturer negotiated with the Federal government a contract which necessitated the construction of a specific plant and related facilities for the sole purpose of producing the goods called for in the contract. Since the goods were required to meet emergency needs of the government, it was possible that, after the plant facilities were constructed, the employees hired, and work on the order begun, the contract would be canceled. The ensuing termination of services of employees hired for this specific job would make the employer's experience rating worse, which in turn would increase the cost of his unemployment compensation taxes. This "possible" cost was recognized as a cost in negotiating the contract.

Describe in order of preference three alternative methods of recording in accounts and/or disclosing on the financial statements the "possible" cost during the course of operations of this emergency plant under the contract. State the reasons for your preference.

(AICPA)

4-11 *Calculation of employees' earnings and bonuses.* Ten men are working as a group on a particular manufacturing project. When the weekly production of the group exceeds a standard number of pieces per hour, each man in the group is paid a bonus for the excess production, in addition to his wages at hourly rates. The amount of the bonus is computed by first determining the

percentage by which the group's production exceeds the standard. One-half of this percentage is then applied to a wage rate of \$1.25 to determine an hourly bonus rate. Each man in the group is paid, as a bonus, this bonus rate applied to his total hours worked during the week. The standard rate of production before a bonus can be earned is 200 pieces per hour.

On the basis of the production record stated below, compute:

1. The rate and amount of bonus for the week.
2. The total wages of Allen, who worked 40 hours at a base rate of \$1 per hour, and of Knoll, who worked 39½ hours at a base rate of \$1.50 per hour.

	Hours worked	Production
Monday.....	72	17,680
Tuesday.....	72	17,348
Wednesday.....	72	18,000
Thursday.....	72	18,560
Friday.....	71.5	17,888
Saturday.....	40	9,600
	399.5	99,076

3. How much is the labor bonus cost to be attached to each unit of the week's production?

(AICPA)

**4-12** *Accounting for overtime premium.* A. J. Goldman & Sons operated a printing shop. During November, 1964, the plant was operating at full capacity. The materials and labor costs of job 102 and all other jobs worked on in November are shown below:

	Job 102	All other jobs	Total
Materials.....	\$5,000	\$35,000	\$40,000
Direct labor.....	6,000	14,000	20,000
Overtime premium.....	2,000	-0-	2,000

In addition to the foregoing costs, factory overhead incurred in November amounted to \$22,000. Overhead is allocated to production on the basis of direct-labor costs.

*Required:*

1. Show what the factory profit or loss on job 102 would be, using two different methods of accounting for overtime premium. Assume that the contract price for this job is \$20,000.
2. Indicate under what circumstances each method should be used.
3. Will the profit or loss of the company during November be affected by the choice of one method or another?

**4-13** *Payroll accounting.* The Cardinal Company's payroll for the first week in February, 1965, was as shown on the following page:

	Gross pay			Deductions				Net pay
	Regular	Overtime premium	Total gross pay	F.I.C.A.	Income taxes	Union dues	Pension	
Factory:								
Direct labor...	\$12,800*	\$1,200	\$14,000	\$500	\$1,600	\$140	\$420	\$11,340
Indirect labor...	5,200	400	5,600	160	750	56	168	4,466
Sales.....	3,600	—0—	3,600	100	400	—0—	108	2,992
Administrative...	1,400		1,400	70	200		42	1,088
Total.....	\$23,000	\$1,600	\$24,600	\$830	\$2,950	\$196	\$738	\$19,886

\* Direct labor includes \$280 paid to trainees for which there was no good production and \$190 devoted to rework.

The Cardinal Company maintains a separate factory ledger. All payroll and tax-liability accounts are kept in the general ledger. State Unemployment Compensation tax is to be accrued at 2.7 percent of the gross payroll and Federal Unemployment Compensation tax at .3 percent. The company matches the pension contributions of employees. Both the employees' and company's pension contributions are turned over to a trustee, who administers the fund. The company's policy is to include in Direct Labor only the cost of regular productive hours worked.

*Required:* Record all entries for the accrual of the payroll on both the factory and the general ledger. Itemize the amounts to be charged to the subsidiary factory overhead ledger.

- 4-14 *Labor cost control.* The Empire Pipe Company manufactures a line of smoking pipes at its plant in Boston. All direct and indirect laborers, except supervisors, are paid on an hourly basis. Labor costs are controlled by management through a labor efficiency report, as shown below:

**EMPIRE PIPE COMPANY**  
**Monthly Labor Efficiency Report**  
 Month of \_\_\_\_\_

	This month	Last month
Direct labor.....	\$12,200	\$14,040
Supervision.....	1,500	1,500
Material handlers.....	1,400	1,550
Inspectors.....	1,800	1,910
Maintenance and repair labor.....	1,600	1,600
Clerical.....	1,200	1,200
Total labor costs.....	\$19,700	\$21,800
Sales value of production.....	\$68,000	\$83,000
Labor costs as a % sales value of production.....	29.0%	26.3%



*Required:*

1. Has there been an improvement in labor efficiency?
2. What factors might have caused the change in the percentage relationship between labor costs and the sales value of production?
3. What is your opinion of the value of this type of report? Can you suggest a better way to control labor costs?

4-15

*Relevant labor costs.* The Ace Novelty Company can use either material A or material B in its mixing and cooking departments. Material A costs 50 cents a pound and can be processed at a rate of 25 lb per hour. Material B costs 45 cents a pound, but only 20 lb can be mixed and cooked in an hour. The company's annual production schedule requires the use of 100,000 lb of material (either A or B). The mixing and cooking departments are operating at approximately 65 percent of practical capacity. The average labor rate per hour is \$3.

The overhead for the mixing and cooking departments during the coming year, at the 4,000-hour level of activity, is estimated at \$20,000, or \$5 per hour. All of these overhead costs are regarded as fixed except for labor fringe benefits, which are expected to amount to 50 cents per hour.

The company's cost accountant has recommended that material A should be purchased on the basis of the following calculation:

Direct labor saved through use of A (1,000 hr @ \$3).....	\$3,000
Overhead saved through use of A (1,000 hr @ \$5).....	5,000
Total.....	\$8,000
Less: Extra cost of A (100,000 lb @ \$.05).....	5,000
Net savings through use of A.....	<u>\$3,000</u>

*Required:* Do you agree with the cost accountant's analysis?

4-16

*The effect of labor payment plan on profitability.* The L & M Company manufactures a single product. Its condensed profit and loss statement for the year ending December 31, 1962, is as follows (no inventories were on hand at the beginning and end of the year):

Sales.....	\$450,000
Cost of sales.....	280,000
Gross profit.....	<u>\$170,000</u>
Less: Selling and administrative expenses:	
Variable.....	\$ 40,000
Fixed.....	90,000
Total.....	<u>\$130,000</u>
Net profit.....	<u>\$ 40,000</u>

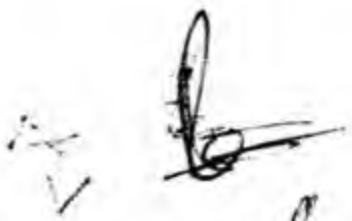
In January, 1963, the company's management was engaged in negotiations with union representatives. During 1962, 30,000 hours of direct labor was worked, and 1 million units were produced and sold. Total and unit costs were as follows:

	<i>Total costs</i>	<i>Unit costs</i>
Materials.....	\$120,000	\$ .12
Direct labor.....	60,000	.06
Variable overhead.....	20,000	.02
Fixed overhead.....	80,000	.08
Total.....	<u>\$280,000</u>	<u>\$ .28</u>

The company's industrial engineering department, on the basis of extensive studies, claimed that, if a straight piecework plan were adopted instead of the present hourly wage rates, labor productivity could be expected to rise by 10 percent. The union had demanded a 10 percent "across the board" increase in hourly rates. It now indicates a willingness to accept a piece-rate system, provided the rate per piece is established at 7 cents.

*Required:*

1. Which costs are relevant in a decision of this type?
2. From the company's standpoint, which of these two alternatives is more profitable (assume that 1963 costs will adhere to the same pattern as in 1962, except for labor)?
3. Should the company's long-run viewpoint toward these alternatives be different from its short-run viewpoint?



## 5. Classification and Allocation of Factory-overhead Costs

### *Introduction*

This chapter is concerned with the nature of factory-overhead costs and the methods used to classify such costs and assign them to goods manufactured. Factory-overhead costs, it will be recalled, consist of all factory costs that are not classified as direct labor or direct raw materials. Although selling expenses and general and administrative expenses also are frequently referred to as overhead, these expenses are not a part of factory overhead.

In accounting for factory-overhead costs two problems are encountered which generally are not present in accounting for materials and direct-labor costs:

1. Whereas materials and labor costs are variable, a substantial portion of factory-overhead costs are fixed. As a consequence, the factory-overhead cost per unit rises as output declines and decreases as higher production levels are attained. Thus, both product costs and income for the period are affected by the level of factory activity.

2. Unlike materials and labor costs, the bulk of factory-overhead costs are indirect in nature and cannot easily be identified with specific departments or products.

### *Nature and classification of factory-overhead costs*

#### **Classification by object of expenditure**

"Object of expenditure" describes the item or object for which funds have been or will be spent. Factory overhead may be subdivided by object of expenditure into three categories: indirect materials, indirect labor, and general factory overhead.

Examples of indirect materials are such *tangible* items as lubricating oils, cleaning materials, and supplies which are necessary for the manufacture of, but do not physically become a part of, the finished product. Included in indirect labor are the costs of the services of various types of factory personnel who do not physically work on the fabrication of products but whose services nevertheless are necessary for the manufacture of the finished product, as for example, supervisors, receivers, material handlers, and building maintenance personnel.

In addition to indirect materials and indirect labor, factory overhead includes the cost of acquiring and maintaining production facilities and miscellaneous factory costs. This third category of factory-overhead costs is referred to as *general factory overhead*. Included in this category are depreciation of plant and facilities, rent, heat, light, power, property taxes, insurance, telephone, travel, etc.

### Direct and indirect factory overhead

A *direct cost* is one which can be specifically traced to a business segment such as plant, department, or product. An *indirect cost* cannot be specifically identified with such segments and must be assigned, or allocated, to them on some basis.

In common usage, the expression that a cost is "direct" means that it is direct with respect to *product* unless the expression is otherwise qualified. That is, the expression that "the material cost is a direct cost" means that it is direct with respect to product; the expression that "the material cost is a direct cost of Department A" means that it is direct with respect to product *and* with respect to Department A.

Raw materials and direct-labor costs generally are direct with respect to both departments and products. Factory-overhead costs normally are indirect with respect to products being manufactured. However, certain factory-overhead costs may be direct with respect to particular departments. For example, the cost of the services of the foreman of a production department (indirect labor) is direct with respect to the department but indirect with respect to the product, because the foreman does not actually work on the product. The same is true of (indirect) materials or supplies which physically do not become a part of the finished product.

As a matter of convenience, certain direct-materials and direct-labor costs which are rather minor in importance are treated as factory overhead. In such circumstances, this portion of factory overhead, technically, is direct with respect to product.

All factory-overhead costs are direct with respect to the factory or plant. Some of these, however, may be indirect with respect to individual departments within the plant. For example, plant depreciation and salary of the plant manager are direct plant costs but indirect with respect to departments and products.

The direct or indirect relationship of a cost to a product is the most important for product-costing purposes. Direct-product costs are assigned

directly to products; indirect-product costs must be allocated to products on some basis.

The direct or indirect relationship of a cost to a department or process is most important for management control purposes. Most direct-department costs are controllable by the department supervisor. Indirect-department overhead costs usually cannot be controlled by the department head, because the authority for their incurrence rests with some one at a higher level of management, such as plant manager, or with another department head, such as a service department manager.

It should be noted that the direct-indirect distinction is especially important for product-costing purposes whenever more than one product is manufactured and for control purposes whenever more than one department or plant is used to manufacture products. Most modern industrial firms are multiproduct, and larger firms tend to become compartmentalized into departments, plants, divisions, etc.

### **Plant- and department-overhead costs**

Factory-overhead costs may relate directly to the plant as a whole, to service departments, or to production departments. Since manufacturing occurs only in producing departments, in order to attach factory-overhead costs to products or jobs manufactured, ultimately all factory-overhead costs must either be charged directly to producing departments or assigned to them on some basis of allocation.

*Plant overhead* includes all costs related to the factory as a whole, as distinguished from its component departments. The function of these costs is to provide and maintain space and facilities for both producing and service departments. Plant-overhead costs must therefore be allocated to these departments.

Service department costs are those costs which can be traced to the operation of service departments such as factory office, the maintenance department, and plant purchasing department. The objects of expenditure for such costs include such items as salaries of engineers and cost accountants, purchasing department clerks, and supplies utilized in operating service departments. Since the function of service departments is to perform services for producing departments, service department costs must be charged to producing departments on some basis. After these costs have been assigned to producing departments for product-costing purposes, they are described as "allocated service department costs."

After plant-overhead and service department costs have been allocated to producing departments, the overhead of a producing department consists of the following classes of items:

#### **Direct departmental overhead:**

- Indirect materials used in department

- Indirect labor incurred in department



General factory overhead directly related to department (e.g., depreciation on department machinery)

Indirect departmental overhead:

Allocated plant overhead (e.g., depreciation of portion of factory used by department)

Allocated service department costs

### Fixed and variable factory overhead

In addition to the possibility of describing factory-overhead costs by object of expenditure and by their directness or indirectness with respect to products and departments, they may be classified according to their behavior with respect to production activity and with time. Those costs whose total amount changes or varies as activity changes or varies are known as *variable* costs. Those costs whose total amount does not change or vary with production activity are called *fixed* costs. Stated another way, fixed costs may be said to vary with time rather than with activity; i.e., they will be incurred during a time period even though no production activity takes place.

There are three types of fixed costs:

1. Long-run capacity fixed costs
2. Operating fixed costs
3. Programmed fixed costs

Long-run capacity costs are the expired costs of plant, machinery, and other facilities used. The expenditures for these fixed assets are made infrequently, and their benefits are expected to extend over a relatively long period of time. Depreciation and amortization are examples of this type of fixed cost.

Operating fixed costs are costs required to maintain and operate the fixed assets. Heat, light, power, insurance, and property taxes are examples of this type of fixed cost.

Programmed fixed costs are the costs of special programs approved by management. The cost of an extensive advertising program or the cost of a program to improve the quality of the firm's products are examples of programmed fixed costs.

In addition to the fixed and variable classifications, there are many overhead items which do not vary directly and proportionately with changes in production activity. Such costs are called *semivariable*, or *semifixed*, costs. As a matter of simplicity, overhead costs in this category are often classified as either fixed or variable, depending on their predominant characteristic.

An example of a semivariable cost is that of the salary of a foreman. Suppose that a factory department presently is employing 20 direct laborers and that the department requires one foreman for each group of 20 workers. As production activity increases, 6 additional direct laborers are hired, thus requiring that an additional foreman be employed to

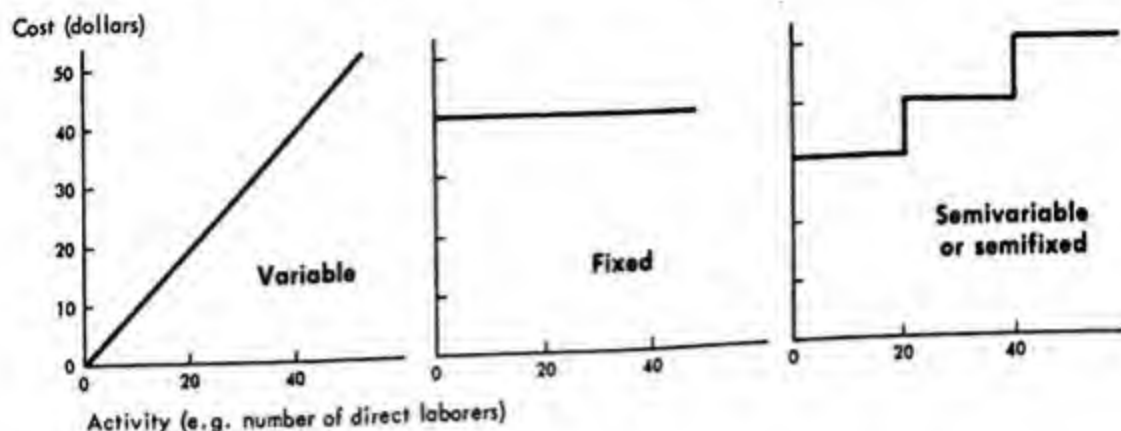


Fig. 5-1 Patterns of cost variability.

supervise the 6 workers. The firm can, however, hire 14 more direct laborers without hiring another foreman. Technically, for the activity level range of 20 to 21 men, the cost of the services of the second foreman is variable; for the range of 21 to 40 men, the cost is fixed.

The distinction between fixed and variable costs often is dependent on management definition and the nature of the company's activities. Management policy may be opposed to discharging supervisors. Accordingly, supervision would be a fixed cost. In a highly automated company, even the services of direct laborers might be fixed.

Variable, fixed, and semivariable costs may be diagrammatically illustrated as shown in Fig. 5-1.

The diagram for variable costs is oversimplified. The diagram indicates that variable costs vary *directly* and *proportionately* with production activity. Stated another way, the curve drawn here is *linear*; that is, it is a straight line. In reality, it may be *curvilinear*; i.e., it may curve up or down. In other words, costs may change directly with production activity, but the change in cost may be greater or less than in proportion to the change in production activity.

Fixed costs ordinarily are indirect with respect to product but may be direct with respect to department or plant. Variable costs tend to be direct with respect to product, department, and plant.

The distinction between fixed and variable costs is useful to management in studies of break-even points, planning and budgeting, and decisions involving levels of activity, such as programs of expansion or contraction. These topics will be discussed in subsequent chapters.

### Importance of different classifications of factory overhead

All the types of factory-overhead cost classifications discussed may be useful. The advent of electronic data-processing equipment with its great capacity for storing data makes it possible to maintain a record of costs by virtually all characteristics.

The classification of costs according to the department which has primary control over their incurrence is useful for managerial control of operations. The object of expenditure classification may be useful in analyzing the production cost of a product into its various elements. The variable-fixed classification is useful in preparing budgets for future operations. Costs classified according to directness or indirectness with respect to product or to department are an aid in determining profitability of product lines or the contribution of a department to the profits of the firm.

For product-costing purposes, all costs incurred in the factory eventually are assigned to the production departments through which the product passes. The accumulation and classification of costs by departments is usually called the *distribution, assignment, or allocation* of costs. Those costs which are traceable directly to the department are assigned directly. Indirect factory-overhead costs and service department costs are allocated on some basis to the production departments and are also attached to production as it flows through the departments.

It is possible to satisfy both the product-costing and control objectives in the following way: First, assign to a department (including each service department) those costs which are controllable by that department. Secondly, prepare information and control reports on each production and service department for management use. Finally, for product-costing purposes, assign noncontrollable costs and allocate service department costs to the production departments. In this way, a single cost accounting system can provide the cost data for the two purposes; the data are merely recombined for each purpose.

Generally, costs which are direct with respect to a department are controllable, at least in part, by that department, whereas costs which have an indirect relationship to a department are not controllable by that department. Thus, the classification of costs within a cost accounting system according to their direct or indirect relationship with particular departments is close to the objective of classifying them according to controllability. Similarly, those costs which are direct with respect to a department frequently also are variable costs; many of those which have an indirect relationship are of a fixed nature.

### *The accumulation of factory-overhead costs*

**Arrangement of overhead cost accounts for cost control purposes**  
Factory-overhead costs might be accumulated by object of expenditure, such as indirect materials, and depreciation of plant and equipment in a single subsidiary ledger which supports a single control account for the entire factory. Ordinarily, however, the factory is organizationally divided into departments, or cost centers, frequently on a functional, or "type of work performed," basis. In such circumstances, it is useful to maintain a

Factory Overhead Control account and subsidiary ledger for each production and service department of the factory.

Departments might also be further subdivided into small organizational entities, in which case it may be worthwhile to maintain a separate Factory Overhead Control account and subsidiary ledger for each of the smaller divisional units within each department. The size of the firm, the nature of the manufacturing process, and the responsibility levels of management are some of the factors which determine the structure of the cost accounts.

In larger firms it is usually worthwhile to break down the entire factory operation into several smaller control units or departments, because smaller units are more manageable. Also, there ordinarily is more delegation of authority and responsibility by top management than there is in smaller firms.

The influence of the nature of the manufacturing process upon the arrangement of the cost accounts can easily be understood. It is rather difficult to break down on paper a long, continuous assembly-line operation into departments where no employee or group of employees on the line substantially changes the product at any particular point. The smallest control unit or department possible may simply be Assembly Department. On the other hand, where rather specialized operations are performed at specific points along the assembly line, it is easier to subdivide Assembly Department into smaller control units such as, for example, Assembly A, Assembly B, etc.

Assuming that the cost accounts are to be kept by department, Exhibit 5-1 portrays the arrangement of factory-overhead accounts which might be used by the hypothetical Darr Company whose factory is organized into production departments A and B and two service departments—factory office and maintenance. Those factory-overhead costs in the illustration which cannot easily be identified with any particular production department or service department are collected in the Plant Overhead Control account and subsidiary ledger. Later, for product-costing purposes, they will be allocated to specific production and service departments.

Any given firm may have several production departments and several service departments; only two of each are used here in order that the illustration may be kept simple. Similarly, only a few subsidiary accounts for each department control account are included in the illustration. Typically, each department might have many subsidiary accounts in which factory-overhead costs are classified by object of expenditure.

The classification of factory-overhead costs by departments facilitates the management control objective of cost accounting. The individuals in charge of each department are accountable for many of the costs which have been directly incurred within each department. For control purposes, the incurred factory-overhead costs for each department are compared with a budgeted or standard amount. Variations of actual



*Exhibit 5-1*

**THE DARR COMPANY**  
Departmental Factory-overhead Accounts  
For Cost Control

<i>Control accounts:</i>					
Producing Dept. A Factory Overhead	2,300	Producing Dept. B Factory Overhead	1,200	Factory Office Factory Overhead	1,050
				Maintenance Dept. Factory Overhead	1,300
					General Plant Factory Overhead
					10,800
<i>Subsidiary ledger accounts:</i>					
Indirect Materials	300	Indirect Materials	150	Clerical Salaries	1,000
					Maint. Salaries
					800
					Depr'n—Bldg.
					7,000
					Depr'n—Machinery
					2,400
					Insurance—Bldg.
					200
					Plant Mgr.'s Salary
					800
					Utilities
					400



costs from budgeted or standard costs are analyzed, and corrective action is taken where possible.

In Exhibit 5-1, for example, the manager of production department A is responsible for the incurrence of factory-overhead costs amounting to \$2,300. This amount when compared with a budgeted amount will indicate how favorable or unfavorable the performance of this department was in regard to overhead expenditures. An examination of the subsidiary ledger details will pinpoint which specific overhead items are "out of control." Corrective action may then be taken. Specifically, the arithmetic difference between the incurred amount (\$2,300) and the budgeted amount is known as a *variance*.

Similarly, the manager of the maintenance department is responsible for the incurrence of \$1,300. The plant manager or even a higher-level manager in the firm is responsible for incurring the \$10,800 plant-overhead amount. This amount is not the responsibility of any particular production or service department. For control purposes, it is not allocated to any of these departments at this time.

Procedurally, there are several ways in which these factory overhead costs ultimately get into the departmental accounts, depending upon the particular accounts used. In the case of the Darr Company (Exhibit 5-1), the following entries might have been made:

(1)		
Factory Overhead—Producing Dept. A.....	300	
Factory Overhead—Producing Dept. B.....	150	
Factory Overhead—Factory Office.....	50	
Factory Overhead—Maintenance Dept.....	500	
Materials and Supplies Inventory.....		1,000
(To record the issuance of factory supplies)		
(2)		
Factory Overhead—Producing Dept. A.....	2,000	
Factory Overhead—Producing Dept. B.....	1,050	
Factory Overhead—Factory Office.....	1,000	
Factory Overhead—Maintenance Dept.....	800	
Factory Overhead—General Plant.....	800	
Accrued Payroll.....		5,650
(To record the incurrence of charges for indirect labor)		
(3)		
Factory Overhead—General Plant.....	10,000	
Prepaid Insurance.....		200
Vouchers Payable.....		400
Allowance for Depr'n—Bldg.....		7,000
Allowance for Depr'n—Machinery.....		2,400
(To record charges for expired depreciation and insurance and utilities incurred)		

Each of these entries would also be recorded in the subsidiary ledger accounts supporting each of the factory-overhead control accounts. If a

subsidiary ledger, i.e., perpetual inventory records, is maintained for Materials and Supplies Inventory, credits would, of course, also be made to these accounts. After these entries have been posted, a trial balance of each subsidiary ledger might be prepared to indicate that no posting errors have taken place, as shown below for Producing Dept. A:

Indirect materials.....	\$ 300
Indirect labor.....	2,000
Balance in control account.....	<u>\$2,300</u>

### Arrangement of overhead cost accounts for product-costing purposes

The determination of the cost of goods or products manufactured involves the attaching of *all* factory costs incurred during a period of time to the products manufactured during that period. Since production physically passes through the production departments only, and not through the service departments, all factory-overhead costs therefore must be assigned eventually to production departments for product costing purposes.

In the Darr Company illustration, this is accomplished as follows: (1) plant overhead is allocated (or distributed, assigned) on some basis to the production and service departments, and (2) service department overhead is allocated to the production departments. (Note that the plant-overhead portion of service department overhead technically is *reallocated*.)

After the first allocation step is accomplished, each production and service department will be charged with (1) those factory-overhead costs which have been *assigned directly* to each department because of their direct relationship and (2) a share of the plant overhead which has been allocated to each production and service department on some reasonable basis.

After the second allocation, all factory-overhead costs will have been assigned to the production department factory-overhead accounts. The total cost in the Factory Overhead account for a production department thus has the following "components": (1) factory-overhead costs which are direct with respect to that department and which were assigned directly to that department for control purposes, (2) a share of the allocated plant overhead which is a direct cost of the factory as a whole, rather than of any individual production or service department, and (3) a share of the allocated service department costs which includes those factory-overhead costs which can be associated directly with each service department as well as the portion of the plant overhead which has been allocated to each service department.

Exhibit 5-2 indicates the status of the factory overhead accounts for production departments A and B after all allocations have been made for product-costing purposes.

## Exhibit 5-2

**THE DARR COMPANY**  
 Departmental Factory-overhead Accounts  
 For Product Costing

Factory Overhead Production Dept. A		Factory Overhead Production Dept. B	
	2,300		1,200
(a)	4,320	(a)	4,320
(b)	1,428	(b)	714
(c)	1,184	(c)	1,184
	<u>9,232</u>		<u>7,418</u>

Factory Overhead Factory Office (Service Dept.)		Factory Overhead Maintenance Dept. (Service Dept.)	
	1,050		1,300
(a)	1,080	(a)	1,080
(b)	238	(b)	2,380
	<u>2,368</u>		

Factory Overhead General Plant	
10,800	(a) 10,800

The bases for allocation are as follows (allocated in this order):

	Percent
Factory Overhead—Plant:	
Production Dept. A.....	40
Production Dept. B.....	40
Factory Office.....	10
Maintenance Dept.....	10
Factory Overhead—Maintenance Dept.:	
Production Dept. A.....	60
Production Dept. B.....	30
Factory Office.....	10
Factory Overhead—Factory Office:	
Production Dept. A.....	50
Production Dept. B.....	50

The total of the balances of the accounts in Exhibit 5-2, amounting to \$16,650, is identical with the total of the account balances in Exhibit 5-1. The only thing accomplished by these allocations is a reclassifying of costs. In Exhibit 5-1 factory-overhead costs are classified for control purposes according to their direct relationship with specific production and service departments and with the plant as a whole. In Exhibit 5-2, factory-overhead costs are classified for product-costing purposes. That is, all factory-overhead costs ultimately have been assigned to the two production departments in which costs will be attached to products as they are produced.

### Complexities in the allocation process

The steps of allocating costs from one department to another and then reallocating to a third department can be avoided by determining what effective proportion of each factory-overhead cost eventually is allocated to each production department. In Exhibit 5-2, for example, production department A receives the following allocations of plant overhead directly, and by way of other departments.

40 % of plant overhead, plus

50 % of the 10 % of plant overhead which is allocated to Factory Office, plus

60 % of the 10 % of plant overhead which is allocated to Maintenance Dept., plus

50 % of 10 % of the 10 % of plant overhead which is allocated to Maintenance Dept., whose overhead costs are allocated in turn to Factory Office

The effective proportion of plant overhead costs allocated to production department A is 51½ percent, calculated as follows:

$$\begin{array}{rcl}
 & & 40\% + \\
 50\% \text{ of } 10\% & = & 5\% + \\
 60\% \text{ of } 10\% & = & 6\% + \\
 50\% \text{ of } 10\% \text{ of } 10\% & = & \frac{1}{2}\% \\
 & & \hline
 & & 51\frac{1}{2}\%
 \end{array}$$

The remaining 48½ percent is allocated to production department B. Similar effective proportions can be calculated for the allocation of maintenance department overhead to production departments A and B, and for the allocation of factory office overhead to production departments A and B.

It should be noted that in Exhibit 5-2, no overhead was allocated to any department whose overhead costs have already been allocated. For example, none of the factory office overhead was allocated to plant overhead or to maintenance department overhead. Similarly, no maintenance department overhead was allocated to plant overhead. This was done to keep the illustration simple. Circular allocations such as these would require algebraic solution (which becomes cumbersome when more than



a few departments are involved) or extensive repetitive calculations. The cost of such time-consuming calculations does not equal the value of such refinements in the allocation of factory-overhead costs.

For simplicity, where departments mutually serve each other, adequate accuracy in the allocation of overhead costs can be achieved by ignoring such services where they are rather immaterial in amount or where they tend to cancel each other out. The benefits which the maintenance department receives from the factory office may offset the benefits which the factory office receives from the maintenance department. Thus, factory office overhead need not be allocated to the maintenance department, and maintenance department overhead need not be allocated to the factory office.

The problem of circular allocation can also be minimized by allocating last the factory-overhead costs of those departments which *receive* the most allocations from other departments.

### Accumulating direct factory-overhead costs

Factory-overhead costs which have a direct relationship with a production department or a service department are assigned to that department's Factory Overhead account. In the case of supplies whose consumption can be observed and calculated, costs may be assigned to the consuming production and service departments on the basis of the consumption records of each.

The cost of maintaining consumption records for these items, however, may exceed the value from the greater accuracy obtained. In such cases, it may be more economical to treat these costs as indirect costs and to *allocate* them among the using departments on some reasonable basis. Such allocation may make these costs less useful for control purposes. The cost of cost accounting, however, is an important consideration in determining the desired preciseness of cost allocation and assignment.

The cost of the services of supervisory labor and machines which are utilized in each department can be identified with each department rather easily in cases where the man or the machine is used in no more than one department. The salaries of the men and the depreciation of the machines are assigned directly to the Factory Overhead account of the production or service department in which the men or machines are utilized. It is important to note, however, that the depreciation cost of the machines probably is not controllable by a departmental manager.

In cases in which the men and machines are used in more than one department, the cost of their services becomes an indirect factory-overhead cost with respect to any one production or service department. Costs of this type therefore cannot be assigned to departments directly but must be allocated or prorated on some reasonable basis among using departments, along with other types of factory-overhead costs which are indirect with respect to specific departments.



Factory-overhead costs are accumulated and allocated periodically, generally monthly. Certain costs which are direct with respect to departments, such as indirect materials and indirect labor, may be charged to departments throughout the month as their amount becomes known. Factory-overhead costs which are indirect with respect to departments, such as depreciation of factory building, usually are calculated monthly. The accumulation and allocation of these actual, incurred factory-overhead costs under a job-order cost system basically is no different from the procedure under a process cost system.

### Criteria for allocating overhead

A number of methods may be employed to allocate general plant overhead to producing and service departments, and service department overhead to producing departments. The adoption of a particular method of allocation normally will be based on one of the following criteria:

1. **Actual services rendered.** It would seem logical to allocate overhead on the basis of services actually rendered. This criterion has greatest applicability in situations where the overhead costs can be easily and directly traced to departments receiving the benefits.

An example of the use of this criterion is a machine shop which services several producing departments. Job records might be maintained to record the actual supplies used and machine shop labor incurred on each job for the producing departments. Other machine shop costs might be allocated to these jobs on the basis of machine shop labor hours or dollars incurred. At the close of each month, the total costs shown on the job sheets would be charged to the appropriate producing departments.

While actual services rendered may be a feasible basis of allocation for some overhead costs, it may not be practical or justifiable for others. The actual amount of benefits provided often cannot be measured with any degree of precision, or the cost of obtaining the added precision may not be warranted. For example, the placement and follow-up of certain purchase orders may be more complex and require greater effort on the part of purchasing department personnel than other orders. Yet, it would hardly be practical to attempt to trace the actual time of each member of the purchasing department and the actual use of purchasing department facilities to each order placed.

This criterion also may be inadequate in situations where the magnitude of a service function is geared to potential rather than actual activity levels of the departments which it services. For example, the size of a power plant may be based on full-capacity operations of all departments in a factory. Suppose, however, that during a certain time period one or more producing departments were operating at abnormally low levels whereas the others were operating at full capacity. If the power plant costs were allocated on the basis of actual services rendered during this period, a proportionately greater share of the costs would be charged to those producing departments operating at full capacity.

Since most of the power plant costs are fixed and based on full-capacity operations, this would not represent a satisfactory basis of allocation.

It sometimes is argued that the manager of a department receiving services, i.e., from the general plant or service departments, can exercise some control over their usage and therefore should be charged on the basis of the actual services rendered. However, it is questionable whether this argument has merit, since in most cases these costs are not only indirect but also predominantly fixed in nature. Moreover, the manager of a producing department has little control over the level of activity at which his department operates. This is dependent on the sales department, economic conditions, and other factors over which the department manager has little jurisdiction.

2. Facilities provided. This criterion is relevant to the allocation of general plant facilities to producing and service departments. For example, rent or depreciation of plant building generally is allocated on the basis of space used. This of course assumes that the space has equal value throughout the plant. In a factory this would be a minor consideration. However, in a department store, valuation of space would be an important consideration in the determination of departmental profit contributions.

3. Potential consumption. According to this criterion, overhead costs are allocated on the basis of potential rather than actual services rendered. This criterion has applicability where the service department costs are largely fixed and the service provides for possibility of capacity operations. For example, some companies maintain buses to transport workers to and from their factory. If the size of the fleet of buses is based on the potential number of users, this would represent a logical basis for allocating these costs to other departments, regardless of the number of actual workers in each department that have availed themselves of this service during a particular month.

4. General use indices. Frequently data pertaining to actual services rendered cannot be obtained. In such situations, a general use index may be employed. The index selected presumably is closely related to the assumed flow of overhead costs. Thus, the services of the cost accounting department often may be allocated to producing departments and other service departments on the basis of the number of employees in each department. General use indices do not result in perfect allocations of overhead. For example, the work of the cost accounting department conceivably may be devoted to a relatively greater extent to a department with fewer employees but more complex cost problems. In addition, the bulk of cost accounting costs are apt to be fixed and unrelated to the size of the work force.

5. Variable and fixed bases. Generally, the costs of a service department are essentially fixed. However, in some situations, the variable portion of a service department's costs may be of sufficient importance to warrant special treatment. For example, in a power plant the fixed

costs might be allocated on the basis of potential usage and the variable costs on the basis of actual usage. Separating the variable and fixed elements of service department costs not only may result in more equitable overhead allocations but also provides useful information for management decisions. The variable costs generally are out-of-pocket or eliminable costs and thus may have particular significance in decision making.

### Methods for allocating overhead costs

The specific methods used to allocate plant overhead and service department costs vary from company to company. In part, this is due to differences in organization structures. It also can be attributed to the degree of refinement desired by management in their costing system and the types of records maintained. For example, if individual plant asset records are kept, depreciation of machinery can be charged directly to departments. Otherwise, it is apt to be included in plant overhead and allocated to departments on some basis. The selection of particular methods of allocation also depends on the judgment of the individual charged with this responsibility.

For these reasons, it is difficult to argue that only one method of allocation is appropriate for each overhead cost, under all circumstances. In

### Exhibit 5-3

#### Suggested Methods for Allocating Factory Overhead

<i>Overhead cost</i>	<i>Methods of allocation</i>
<b>Plant overhead:</b>	
Depreciation of building.....	Space occupied
Insurance on building.....	Space occupied
Taxes on building.....	Space occupied
Plant manager's office.....	Number of employees, cost of production
Heat.....	Space occupied, heating outlets
Light.....	Space occupied, light outlets, kilowatthours
Power.....	Space occupied, horsepower-hours, machine capacities, machine hours
<b>Service department costs:</b>	
Receiving.....	Cost of materials purchased, number of items received
Purchasing.....	Cost of materials purchased, number of orders placed
Stores.....	Cost of materials used, number of requisitions filled
Cost accounting.....	Number of employees, hours worked
Personnel.....	Number of employees, hours worked
Machine shop.....	Job costs, machine hours, labor hours
Power plant.....	Metered horsepower hours, capacity of machines, machine hours
Building maintenance.....	Space occupied

Exhibit 5-4

THE HASTING CORPORATION  
Overhead Distribution Analysis

Month of \_\_\_\_\_

	Basis of allocation	Producing depts.			Service depts.			Total
		Sanding	Painting	Assembly and packing	Receiving and storing	Machine shop	Power plant	
Direct overhead costs:								
Supplies.....	Direct	\$ 28,000	\$ 39,000	\$ 79,000	\$ 5,000	\$ 10,000	\$ 11,000	\$172,000
Indirect labor.....	Direct	43,000	47,000	86,000	11,000	18,000	14,000	219,000
Depreciation—machinery.....	Direct	2,000	4,000	2,000	1,000	2,000	9,000	20,000
Plant overhead costs:								
Factory office.....	Employees	1,500	2,500	4,000	600	800	600	10,000
Purchasing.....	Orders	1,100	500	400	100	300	300	2,700
Building occupancy.....	Space	6,500	4,600	12,600	200	1,100	4,000	29,000
Total overhead.....		\$ 82,100	\$ 97,600	\$184,000	\$17,900	\$ 32,200	\$ 38,900	\$452,700
Allocation of service dept. costs:								
Receiving and stores.....	Requisitions	9,900	2,300	2,800	(17,900)	1,000	1,900	
Machine shop.....	Jobs	6,300	13,500	8,200		\$(33,200)	5,200	
Power plant.....	Hp-hr	21,600	17,400	7,000			\$(46,000)	
Total producing dept. overhead.....		\$119,900	\$130,800	\$202,000				



Exhibit 5-3, a list of suggested methods or bases for allocating overhead is presented.

### Overhead distribution analysis

The distribution of plant overhead to producing and service departments and service department costs to producing departments generally is made on a schedule called an *overhead distribution analysis*. This is illustrated in Exhibit 5-4 for the Hastings Corporation. The total direct and indirect overhead costs accumulated for the producing departments will be attached to products manufactured. Journal entries tracing the flow of overhead costs will be made on the basis of the distributions shown on the overhead distribution analysis.

## The effect on factory-overhead costs of changes in volume

### Factory-overhead unit costs and volume

Some of the difficulties associated with accounting for overhead costs are apparent when the effect of volume on overhead costs is examined. Since a large portion of factory overhead costs is fixed and indirect with respect either to product or to departments, their *total* amount tends to remain constant in spite of changes in the level of operations. A change in the level of operations, however, may have an important direct effect upon overhead cost *per unit* of product.

Suppose a firm is engaged in the production of product A and has decided to diversify its operations by producing a new product, product B. Assume that the production of product B will require additional direct labor and direct material but no additional factory-overhead costs will be incurred as a result of the added product line. Pertinent production cost data are as follows:

	Total	Per unit
Cost of producing 10,000 units of product A:		
Direct labor.....	\$10,000	\$1.00
Direct materials.....	5,000	.50
Factory overhead incurred.....	30,000	3.00
Total.....	\$45,000	\$4.50
Added costs of producing 5,000 units of product B:		
Direct labor.....	\$ 2,000	\$ .40
Direct materials.....	8,000	1.60
Factory overhead incurred.....	-0-	-0-
Total.....	\$10,000	\$2.00

The marginal cost per unit of product B is \$2 and the direct cost per unit of product B is \$2. However, under absorption costing, factory over-



head is spread over all production. In this illustration, the unit cost of both products A and B is affected. Some of the total factory-overhead costs of \$30,000 is assigned to product B. Therefore, this reduces the total overhead cost assigned to product A. Using units of production as the basis for assigning this overhead to products, the cost data after undertaking production of product B are as follows:

	Total	Per unit
Product A production (10,000 units):		
Direct labor.....	\$10,000	\$1.00
Direct materials.....	5,000	.50
Factory overhead.....	20,000	2.00
Total.....	\$35,000	\$3.50
Product B production (5,000 units):		
Direct labor.....	\$ 2,000	\$ .40
Direct materials.....	8,000	1.60
Factory overhead.....	10,000	2.00
Total.....	\$20,000	\$4.00

The increase in production activity due to the enlarged scope of activities caused no increase in total incurred factory overhead. The change in activity did, however, decrease the *total* amount of factory overhead assigned to the production of product A and consequently decreased the factory-overhead *unit* cost of product A from \$3 to \$2. In addition, although the undertaking of product B production did not cause added factory overhead to be incurred by the firm as a whole, under traditional absorption costing for product-costing purposes, \$10,000 of the overhead which previously was charged to product A is now charged to product B. Although it is unusual that there would not be *some additional* factory overhead incurred in taking on a new product line, the assumption that no additional factory overhead is incurred is made in the illustration for simplicity reasons.

Although the marginal or direct cost per unit of product B is \$2 ( $$.40 + $1.60$ ), the assigned factory overhead of \$10,000 makes the unit cost of product B \$4 on an absorption cost basis.

From a management point of view, the firm would add to its total profits as long as product B is sold for more than \$2 per unit. If the customers who buy product B are different from those who buy product A, it is sometimes argued that a \$2.10 price for B, for example, would be discriminatory and inequitable. Presumably the equitable action is to charge some of the factory overhead to product B and to establish the selling price on an absorption basis, with perhaps a reduction in the selling price of product A based upon decreased cost.

Full-cost pricing, marginal-cost, or differential-cost, pricing, and other pricing methods are discussed in detail in a later chapter. The problems

of cost and price relationships are mentioned here in passing for purposes of illustrating the importance and effects of overhead allocations for purposes other than costing products for income determination and balance sheet valuation.

An understanding of the effect of the level of production activity on factory-overhead total and unit costs is important for management decision makers. A lack of understanding, which frequently is exhibited, results in erroneous analysis, as may occur in the decision of whether or not to go into the production of product B and in determining what the unit cost of product B on an absorption cost basis would be. Such *erroneous* analysis, using the same illustration, would be as follows: The factory-overhead cost per unit of product A prior to adding product B is \$3 per unit. This overhead rate, or cost per unit, often is erroneously applied to new products. Accordingly, if 5,000 units of product B are manufactured, they will be assumed to cost \$5 per unit ( $$.40 + \$1.60 + \$3$ ) for a total of \$25,000. The total cost of producing both product A and product B is thus \$70,000 ( $\$45,000 + \$25,000$ ) composed of:

Direct labor .....	\$12,000
Direct material .....	13,000
Factory overhead .....	45,000
Total .....	<u>\$70,000</u>

The error in the analysis is evident. Factory overhead after product B production is still only \$30,000 rather than \$45,000, and total production cost is \$55,000 rather than \$70,000.

To summarize the point, (1) for decision-making purposes, only the marginal, direct, or variable costs are relevant; (2) when the scale of operations is changed, such as is the case when an additional job is undertaken, a new product line is adopted, or more plant facilities are added, fixed factory-overhead cost per unit of product changes.

### Effect of volume change upon income and cash

To gain an understanding of the nature of fixed costs and their behavior when production volume changes, assume that the Brown Company has the following balance sheet on January 1:

Cash .....	\$ 100,000	Capital stock .....	\$1,000,000
Factory building .....	\$1,200,000	Retained earnings .....	300,000
	<u>\$1,300,000</u>		<u>\$1,300,000</u>

For simplicity, assume that direct materials and labor vary directly with production and that they amount in total to \$20 per unit of product manufactured. Assume that materials and labor are purchased for cash and that there are no inventories. Assume also a 20-year life for the factory building, making depreciation, a fixed cost, of \$60,000 per year on a straight-line basis. Ignore all other possible costs.

If, during the year, 4,000 units of product are produced and sold for \$40 cash per unit, the income statement for the year would be as follows:

Revenues.....		\$160,000
Costs:		
Materials and labor.....	\$80,000	
Depreciation.....	<u>60,000</u>	<u>140,000</u>
Income.....		<u>\$ 20,000</u>

The cash balance at the end of the year would be \$180,000 (\$100,000 + \$160,000 - \$80,000) and income would be \$20,000 for the year. The unit cost of goods sold would be \$35, indicating a profit per unit of \$5.

Suppose that the firm had planned to produce and sell for cash during the year 5,000 units at a unit price of \$40. The budgeted income statement was as follows under this assumption:

Revenues.....		\$200,000
Costs:		
Materials and labor.....	\$100,000	
Depreciation.....	<u>60,000</u>	<u>160,000</u>
Income.....		<u>\$ 40,000</u>

The cash balance at the end of the year was budgeted to be \$200,000 (\$100,000 + \$200,000 - \$100,000), or 10+ percent greater than actually was the case. Budgeted income was \$40,000, or 100 percent greater than the actual income of \$20,000. Budgeted unit cost of goods sold was \$32, or about 9 percent less than actual. Budgeted volume was 25 percent greater than actual volume.

In this case, the effect of fixed factory-overhead costs is apparent from a summary of the comparison of budgeted and actual results: 25 percent increase in volume would have resulted in a 100 percent increase in income, a 10 percent increase in the ending cash balance, and approximately a 9 percent decrease in the unit cost of goods produced and sold.

The increased volume would have spread the fixed factory-overhead (depreciation) costs of the Brown Company over a larger number of units and thus reduced the per unit cost of product. Assuming that the additional units were sold at \$40, they would have doubled the firm's income, because each of them cost only an additional \$20 per unit for materials and labor. Hence,  $\$40 - \$20 \times 1,000 = \$20,000$  of additional income and of additional cash.

This technique for reducing unit cost of goods produced and sold, increasing income, and adding to the cash balance is known as *operating leverage*. The existence of fixed costs is necessary for the use of this technique. The greater the percent of fixed costs relative to total costs, the greater and more powerful is the leverage. Operating leverage should not be confused with *financial leverage*, which involves the relationship of debt and equity methods of financing a business.

## Problems and cases

- 5-1 *Objectives of overhead costing.* What are the objectives of overhead costing?
- 5-2 *Overhead costing problems.* What special problems are presented by overhead costing?
- 5-3 *Overhead allocation procedures.* Why is it more desirable first to charge relevant overhead costs to service departments and then to assign them to production departments, rather than to allocate them directly to production departments?
- 5-4 *Operating leverage.* What is meant by operating leverage? Does a firm's operating leverage influence its policies?
- 5-5 *Controllability of overhead costs.* Are all overhead costs controllable? Explain.
- 5-6 *Fixed and variable overhead costs.* Why is it important for the cost accountant to make a distinction between fixed and variable overhead costs?
- 5-7 *Types of fixed overhead costs.* Define and provide an example of a sunk fixed cost, an out-of-pocket fixed cost, and a programmed fixed cost.
- 5-8 *Accuracy of unit overhead costs.* "Overhead costing procedures provide the precise overhead costs of units manufactured." Comment.
- 5-9 *Selection of the base for overhead allocations.* What principle should underlie the selection of a base for allocating overhead?
- 5-10 *Direct and indirect factory overhead.* For each of the following cost items, indicate whether it may be direct or indirect with respect to a product, a production department, a service department, a plant, and the entire corporate firm:
1. Vacation pay of maintenance department employees in plant A
  2. Pension plan costs of the corporation's president
  3. Property tax on factory equipment in the assembly department of plant B
  4. Advertising cost of promoting product X of plant A
  5. Cost of parts used to repair machines in the office of the sales manager of plant C
  6. Depreciation on the office furniture of the controller's office of plant B
- 5-11 *Fixed and variable factory overhead.* Classify the cost items in problem 5-10 according to their probable fixed and variable nature.
- 5-12 *Controllable and noncontrollable factory overhead.* Indicate for each cost item in problem 5-10 the individual manager who might be responsible for control of the cost.
- 5-13 *Methods for allocating overhead costs.* Describe the different methods that may be used to allocate factory overhead from general plant to service and producing departments, from service departments to producing departments, and from producing departments to jobs.
- 5-14 *Overhead allocation methods.* The Monongah Machine Shop, Inc., consists of two departments. Operating statistics for 1963 were as follows:



	Dept. 1	Dept. 2
Raw materials used.....	\$60,000	\$20,000
Direct labor incurred.....	\$24,000	\$54,000
Machine hours.....	12,000	18,000
Factory overhead.....	\$48,000	\$54,000

During the first week of January, 1964, the company was asked to quote a price on a prospective job. The company's policy is to quote prices on the basis of estimated factory costs plus 40 percent. Estimated data relevant to this particular job are as shown below:

	Dept. 1	Dept. 2
Estimated materials.....	\$4,000	\$1,000
Estimated direct labor.....	\$1,000	\$9,000
Estimated machine hours.....	600	2,000

Using the actual results of 1963 as the basis for assignment of overhead, indicate what selling price should be quoted, based on four different assumptions as to how overhead is charged to production.

5-15

*Service department costs.* Given below are the details pertaining to the power service department:

During the month of April, the expenses of operating the power service department amounted to \$9,300; of this amount, \$2,500 was considered to be a fixed cost.

1. What dollar amounts of the power service department expense should be allocated to each producing and service department for product-costing purposes?
2. What are the reasons for allocating the costs of one service department to other service departments as well as to producing departments?

Horsepower-hours

	Production departments		Service departments	
	A	B	X	Y
Needed at capacity production.....	10,000	20,000	12,000	8,000
Used during the month of April.....	8,000	13,000	7,000	6,000

(AICPA)

5-16

*Overhead distribution analysis and journal entries.* The following overhead distribution analysis was prepared for the factory of the Hastings Company. Record all journal entries supporting this analysis.



**THE HASTINGS COMPANY**  
Overhead Distribution  
Month of March, 1964

	Producing departments			Service departments	
	A	B	C	General plant	Maintenance
Supervision.....	\$ 2,200	\$ 1,800	\$1,100	\$ 2,600	\$ 800
Indirect labor.....	2,700	2,000	400	6,400	2,600
Repairs.....	900	1,600	200	400	-0-
Supplies.....	3,400	2,300	700	500	1,100
Depreciation—machinery.....	1,100	1,400	300	200	-0-
Utilities.....	-0-	-0-	-0-	1,900	-0-
Taxes and insurance.....	-0-	-0-	-0-	800	-0-
Depreciation—plant.....	-0-	-0-	-0-	600	-0-
Total.....	\$10,300	\$ 9,100	\$2,700	\$13,400	\$4,500
Allocation—general plant.....	5,300	4,200	2,200	(13,400)	1,700
Total maintenance.....					\$6,200
Allocation—maintenance.....	2,200	2,900	1,100		(6,200)
Total producing.....	\$17,800	\$16,200	\$6,000		

- 5-17 *Analysis of accounts.* The Sweet Odor Tobacco Company started business on January 1, 1964. At the end of the year, the total debits and credits appearing in each of the accounts on the factory ledger are as shown below:

	Debits	Credits	Balance
Raw materials.....	\$170,000	\$150,000	\$ 20,000
Materials in process, Dept. 1.....	140,000	140,000	-0-
Labor in process, Dept. 1.....	120,000	120,000	-0-
Overhead in process, Dept. 1.....	240,000	240,000	-0-
Variable overhead, Dept. 1.....	60,000	60,000	-0-
Fixed overhead, Dept. 1.....	180,000	180,000	-0-
Materials in process, Dept. 2.....	500,000	450,000	50,000
Labor in process, Dept. 2.....	80,000	72,000	8,000
Overhead in process, Dept. 2.....	120,000	108,000	12,000
Variable overhead, Dept. 2.....	40,000	40,000	-0-
Fixed overhead, Dept. 2.....	80,000	80,000	-0-
Service Dept. X, variable costs.....	20,000	20,000	-0-
Service Dept. X, fixed costs.....	60,000	60,000	-0-
Service Dept. Y, variable costs.....	20,000	20,000	-0-
Service Dept. Y, fixed costs.....	80,000	80,000	-0-
Finished goods.....	630,000	577,500	52,500
General ledger.....	587,500	730,000	142,500

Service Department X costs were allocated to Departments 1 and 2 equally, and Service Department Y costs on the basis of direct labor. During the year, 600,000 lb of tobacco was produced and transferred to the finished goods stockroom, and 550,000 lb was sold at \$1.50 a pound.

**Required:**

1. Record all journal entries for transactions recorded on the factory ledger during the year.
2. Assume that the plant is operating at 60 percent of capacity and that the company has an opportunity of accepting a large order for foreign shipment at 85 cents a pound. All shipping costs are to be paid by the customer, and there are no other selling and administrative expenses. Should the order be accepted?

5-18

**Overhead distribution.** A trial balance of the factory-overhead subsidiary ledger of the Waverly Manufacturing Company is presented below for the month ending June 30, 1962. Based on the data disclosed:

1. Prepare an exhibit showing how the overhead is allocated to the three producing departments.
2. Calculate the overhead rate per machine hour in Departments A and B and per labor hour in Department C.
3. Calculate the cost of job 987, which was started and finished during the month. The materials and labor costs applicable to job 987 were, respectively, \$487.92 and \$465. The job required 50 machine hours in Department A, 12 machine hours in Department B, and 20 labor hours in Department C.
4. Can you see any limitations to this method?

Indirect labor.....	\$ 41,740
Factory rent.....	2,400
Insurance—machinery and equipment.....	4,216
Compensation insurance.....	2,486
Superintendence.....	6,000
Factory clerical salaries.....	4,950
Machine maintenance and repairs.....	31,010
Depreciation of machinery and equipment.....	42,800
Fuel.....	3,172
Electricity.....	2,178
Manufacturing supplies used.....	3,617
Social security taxes.....	9,210
Factory office supplies.....	879
Miscellaneous factory expense.....	1,212
Total.....	<u>\$155,870</u>

**Additional data:** The manufacturing operations are carried on in three production departments, A, B, and C, with the aid of two service departments, numbered 1 and 2, respectively. Other data are as follows:

	Total	Departments				
		A	B	C	1	2
Plant floor space, sq. ft. . . . .	30,000	10,000	5,000	2,000	7,500	5,500
Number of employees . . . . .	109	50	20	4	25	10
Number of labor hours . . . . .	113,360	52,000	20,800	4,160	26,000	10,400
Number of machine hours . . . . .	47,952	31,912	9,640	560	5,840	—0—
Salaries and wages . . . . .	\$161,307	\$76,180	\$28,472	\$9,975	\$37,230	\$9,450
Cost of machinery and equipment . . . . .	\$1,019,047	\$623,225	\$250,960	\$20,210	\$112,862	\$11,790
Annual depreciation rates . . . . .	8%	8%	10%	10%	10%	20%

In developing your overhead distribution, expenses shall be distributed to departments as follows:

On the basis of floor space:

Factory rent

Fuel

One-fourth of electricity

On the basis of salaries and wages:

Compensation insurance

Superintendence

Manufacturing supplies used

Social security taxes

Factory office supplies

Miscellaneous factory expense

On the basis of investment in machinery and equipment:

Insurance—machinery and equipment

Machinery maintenance and repairs

Three-fourths of electricity

Depreciation—machinery and equipment

Factory clerical salaries and \$4,500 of indirect labor are charged to Department 2. The balance of indirect labor is charged to Department 1.

Expenses of Department 1 are to be distributed, one-tenth to Department 2, the balance to all other departments on the basis of machine hours.

Expenses of Department 2 are to be distributed to departments A, B, and C on the basis of labor hours.

(AICPA adapted)

**5-19** *Overhead allocations between product lines.* The Alko Chemical Corporation has two departments, separating and treating. Two separating operations are run concurrently. One produces Talco on a government contract. The other manufactures a material which is transferred to the treating department, where it becomes a finished product called Salvo.

During the month of January, 1965, a new cost accountant was employed who was lacking in experience. You are called upon to assist him in recording the transactions on the factory ledger. You find that the amounts recorded in the trial balance which follows are all correct but incomplete:

**ALKO CHEMICAL CORPORATION**  
**Trial Balance—Factory Ledger**  
**As of January 31, 1965**

Raw materials inventory.....	\$120,000	
Raw materials used—separation (gov't)....	47,300 (100,000 lb)	
Raw materials used—separation (reg.).....	77,200 (175,000 lb)	
Raw materials used—treating.....	20,000 (10,000 lb)	
Direct labor—separation (gov't).....	20,000	
Direct labor—separation (reg.).....	30,000	
Direct labor—treating.....	25,000	
Factory overhead—separation.....	30,000	
Factory overhead—treating.....	24,000	
General plant.....	30,000	
Work in process—separation (gov't).....	-0-	
Work in process—separation (reg.).....	-0-	
Work in process—treating.....	-0-	
Finished goods—Talco.....	-0-	
Finished goods—Salvo.....		\$423,500
General ledger.....		<u>\$423,500</u>
Total.....	<u>\$423,500</u>	<u>\$423,500</u>

There was no work in process in either department at the end of January. There is a 20 percent weight loss in separation on both regular and government work. No weight loss occurs in treating.

Sixty percent of the general plant costs are allocated on the basis of space occupied and 40 percent on the basis of direct labor. The separation department occupies 75,000 sq ft, and the treating department 25,000 sq ft of space.

Of the total separating department overhead, \$2,500 can be specifically identified with government work and \$4,000 with regular production. Of the balance of the separating department overhead, 60 percent is allocated on the basis of machine hours and 40 percent on the basis of direct labor. Separators used on government work were in operation 2,000 hours, and those used on regular work 4,000 hours.

During January, 75,000 lb of Talco was shipped at \$1.25 per pound, and 130,000 lb of Salvo was shipped at \$2 per pound. The balances of the selling and delivery and administrative expense accounts on the general ledger were, respectively, \$36,000 and \$20,000. There is no selling expense on government work, but delivery costs amounted to \$3,000. Administrative expenses are allocated on the basis of sales.

*Required:*

1. Record all journal entries necessary to complete the transactions on the factory ledger for January, using all accounts appearing in the trial balance.
2. Prepare an income statement for the month, showing separately the profit on Talco and Salvo.

Sales.....	\$1,000,000
Variable costs	
Materials.....	\$ 300,000
Labor.....	200,000
Overhead.....	100,000
Selling and administrative.....	100,000
Total.....	\$ 700,000
Contribution margin.....	\$ 300,000
Less: Fixed costs.....	250,000
Income.....	<u>\$ 50,000</u>

During the coming year, the company expects to increase the number of units sold 30 percent by reducing the price of its single product from \$10 to \$9.50. In order to sell these additional units, it is necessary to rent more space at an annual cost of \$10,000. During the coming year, materials prices are expected to decline by 50 cents per finished unit. An increase in advertising expenditures of \$15,000 will also be necessary to sell the additional units planned. All variable factory costs vary with units sold and selling, and administrative expenses, primarily selling commissions, vary with sales.

*Required:* Based on the plans indicated, what will the company's income be for next year?

5-21

*Interrelationship of budgeted costs and budgeted sales.* The Metal Products Company manufactures three different models of a single product. From the following data you are to prepare a schedule, supported by computations, showing the sales quantity and sales dollar figure for each model necessary to enable the company to cover its nonvariable costs.

<i>Model number</i>	<i>Annual sales budget, units</i>	<i>Budgeted unit sales price</i>	<i>Budgeted sales allowances for a year</i>
100	30,000	\$15	\$1,260
200	16,000	18	480
300	10,000	25	410

## 1962 Estimates

<i>Model number</i>	<i>Quantity budgeted for production</i>	<i>Over-all estimated cost per unit</i>		
		<i>Total</i>	<i>Variable cost</i>	<i>Nonvariable cost</i>
100	30,500	\$15.072	\$ 9.871	\$5.201
200	15,000	17.335	10.250	7.085
300	10,000	23.756	15.436	8.320

(AICPA)



- 5-22 *Cost variability, income, and cash.* Income statements appear below for the High Leverage and Low Leverage Companies. All variable costs vary with units sold.

	High Leverage Co. (200,000 @ \$5)	Low Leverage Co. (200,000 @ \$5)
Sales.....	\$1,000,000	\$1,000,000
Variable costs		\$ 150,000
Materials.....	\$ 150,000	350,000
Direct labor.....	150,000	250,000
Overhead.....	150,000	50,000
Selling and administrative.....	50,000	
Total.....	\$ 500,000	\$ 800,000
Contribution margin.....	\$ 500,000	\$ 200,000
Less: Fixed costs.....	400,000	100,000
Income.....	\$ 100,000	\$ 100,000

*Required:*

1. By how much will the income of each company increase if 50 percent more units are sold? What is the percentage increase?
2. What will be the amount and percentage increase in cash if units sold are increased by 50 percent, on the assumption that half the fixed costs are out-of-pocket costs?
3. Suppose that each plant is operating at full capacity and that both are considering a plant-expansion program that will add \$50,000 to fixed costs but will increase units sold to 240,000. What will the income of each company be?
4. What is the reason for these differences? What effect does the relationship between fixed and variable costs have on management policies?

- 5-23 *Marginal avoidable direct costs and decision making.* Ace Publishing Company is in the business of publishing and printing guidebooks and directories. The board of directors has engaged you to make a cost study to determine whether or not the company is economically justified in continuing to print, as well as publish, its books and directories. You obtain the following information from the company's cost accounting records for the preceding fiscal year:

	Departments			
	Publishing	Printing	Shipping	Total
Salaries and wages.....	\$275,000	\$150,000	\$25,000	\$ 450,000
Telephone and telegraph...	12,000	3,700	300	16,000
Materials and supplies.....	50,000	250,000	10,000	310,000
Occupancy costs.....	75,000	80,000	10,000	165,000
General and administrative	40,000	30,000	4,000	74,000
Depreciation.....	5,000	40,000	5,000	50,000
	\$457,000	\$553,700	\$54,300	\$1,065,000

*Additional data:*

1. A review of personnel requirements indicates that, if printing is discontinued, the publishing department will need one additional clerk at \$4,000 per year to handle correspondence with the printer. Two layout men and a proofreader will be required at an aggregate annual cost of \$17,000; other personnel in the printing department can be released. One mailing clerk, at \$3,000, will be retained; others in the shipping department can be released. Employees whose employment was being terminated would immediately receive, on the average, 3 months' termination pay. The termination pay would be amortized over a 5-year period.
2. Long-distance telephone and telegraph charges are identified and distributed to the responsible department. The remainder of the telephone bill, representing basic service at a cost of \$4,000, was allocated in the ratio of 10 to publishing, 5 to printing, and 1 to shipping. The discontinuance of printing is not expected to have a material effect on the basic service cost.
3. Shipping supplies consist of cartons, envelopes, and stamps. It is estimated that the cost of envelopes and stamps for mailing material to an outside printer would be \$5,000 per year.
4. If printing is discontinued, the company would retain its present building but would sublet a portion of the space at an annual rental of \$50,000. Taxes, insurance, heat, light, and other occupancy costs would not be significantly affected.
5. One cost clerk would not be required (\$5,000 per year) if printing is discontinued. Other general and administrative personnel would be retained.
6. Included in administrative expenses is interest expense on a 5 percent mortgage loan of \$500,000.
7. Printing and shipping-room machinery and equipment having a net book value of \$300,000 can be sold without gain or loss. These funds in excess of termination pay would be invested in marketable securities earning 5 percent.
8. The company has received a proposal for a 5-year contract from an outside printer, under which the volume of work done last year would be printed at a cost of \$550,000 per year.
9. Assume continued volume and prices at last year's level.

*Required:* Prepare a statement setting forth in comparative form the costs of operation of the printing and shipping departments under the present arrangement and under an arrangement in which inside printing is discontinued. Summarize the net saving or extra cost in case printing is discontinued.

(AICPA)

## 6. **Predetermined Factory Overhead for Product Costing, Planning, and Control**

### *Predetermination of factory overhead*

#### **Reasons for predetermining factory overhead**

In the preceding chapter, the classification, accumulation, and allocation of actual, or incurred, factory-overhead costs were discussed. The allocation of overhead costs to producing departments and to goods manufactured takes place at the close of a time period, generally a month. Not until then are all the events resulting in the incurrence of overhead known and reflected in the cost accounts.

Although this procedure is fairly common in certain process cost situations, it has the following distinct disadvantages:

I. When actual factory overhead costs are allocated to products manufactured, the overhead cost per unit may fluctuate sharply from period to period. This affects the reporting of inventories and income on interim statements and also may have an influence on certain types of management decisions. The reasons for fluctuations in unit factory-overhead costs are as follows:

- a. The rates for indirect labor and the prices of indirect materials may have changed during the period.
- b. The efficiency with which overhead cost factors are utilized may vary. For example, an excessive amount of supplies or indirect labor may be used in a particular month because of poor supervision.
- c. The level of factory activity may change from period to period. Because of the constancy of the fixed costs, the overhead cost per unit increases or decreases as a consequence of fluctuations in output.

- d. Abnormal costs may be incurred in a particular month which are caused, at least in part, by activities of prior months, e.g., excessive machine repairs.
- e. Certain overhead costs are incurred at regular but spaced time intervals. For example, property taxes may be paid twice a year. During the particular months in which these taxes are paid, all other things being equal, the actual overhead cost per unit of product will rise.

Fluctuations in unit overhead costs caused by changes in indirect labor rates and prices of supplies may properly be included in inventoriable product costs. However, accountants are reluctant to increase product costs for inventory and income determination purposes for costs resulting from inefficiency, abnormal cost incurrence, or temporary low levels of activity.

Variations in product costs from month to month are also undesirable from the standpoint of pricing decisions. To the extent that costs may be relevant in pricing, management may be unable to pass on, or may be opposed to passing on, these excess or abnormal costs to customers.

2. Certain management decisions cannot be delayed until actual overhead costs are determined at the end of the period. For example, an estimated overhead figure may be needed in making bids or quotations on jobs or in setting the initial selling price on a new product.

3. In a job shop, management may want to know whether a profit has been earned on jobs at the time when they are completed instead of having to wait until the close of the period when the overhead costs have been calculated.

These limitations of allocating actual overhead to products manufactured may be overcome by predetermining or estimating overhead costs prior to their actual incurrence, applying them to products or jobs manufactured by means of predetermined overhead rates and controlling overhead expenditures by means of variable budgetary allowances. These techniques are all related and will be elaborated on in this chapter.

### The normalizing of factory overhead over time periods

An important benefit resulting from the use of predetermined factory-overhead rates is the elimination of the effect of seasonal differences in incurred factory-overhead costs and of changes in production activity levels upon the unit cost of products manufactured. In other words, factory-overhead costs are "normalized" when a predetermined rate is used.

As an illustration of this normalizing of seasonal fluctuations in incurred overhead, assume that a plant is located in a climate which requires heating in the winter months but not in the summer. If a normal overhead rate were not used and products were costed at the end of each



month on the basis of the factory-overhead costs incurred during that month, only those products manufactured during winter months would be charged with heating costs. Although this might be considered to be reasonable, it is usually considered to be more appropriate to spread such seasonal costs over products manufactured during all the months of the year. The heating costs, for example, are necessary to "keep the concern going," and product costs should not vary during different months simply because of seasonal calendar effects. Property taxes and unusual repairs are additional examples of costs which fall within a particular month but are applicable to longer periods.

The second normalizing effect of the predetermined factory-overhead rate is that of eliminating the effect of production activity changes on the unit cost of products manufactured. To illustrate, assume that incurred factory-overhead costs were identical in amount each month of the year and that each month they amounted to \$10,000 (\$120,000 for the year). Assume that 400 units of product were produced in May and 1,000 were manufactured in June. If a normal or predetermined rate were not used, the products manufactured in May would have a unit overhead cost of \$25, and those in June would be costed at \$10. In addition to the fluctuations of income, the product cost data would be less useful for management decision making.

If a predetermined overhead rate were used, based upon an annual estimated production of 10,000 units of product, the products manufactured during any month would have a unit overhead cost of \$12.

Some plants have normal shutdown periods, such as shutdowns for purposes of giving all employees vacations at the same time and normal shutdown periods which are experienced by seasonal industries such as the canning industry. The cost of these shutdowns can be provided for in calculating the predetermined overhead rate. Under this procedure, as overhead is applied to products by means of the predetermined rate, products manufactured throughout the year will be charged with a portion of the shutdown costs.

### The predetermined factory-overhead rate

The problem of making a factory-overhead cost figure available prior to the more precise determination of the incurred amount is accomplished through the use of a predetermined or normal factory-overhead rate. The predetermined factory-overhead rate is the vehicle for *applying* factory overhead, or attaching factory-overhead costs to products as they pass through production departments to which these costs have been assigned, or allocated. Predetermined factory-overhead rates are useful in both job-order and process cost systems. The need for predetermined overhead rates is perhaps most obvious in the job-order system in which product costs are needed prior to the end of the period, when incurred overhead costs typically are computed.

The predetermined or normal overhead rate is derived by estimating



overhead costs for a period of time, generally 1 year in advance. Since variable overhead costs differ at different levels of operation, it first is necessary to establish the volume of output for which the factory-overhead costs are to be predetermined. This level of activity is expressed in terms of a base, such as direct-labor dollars or hours, or machine hours, which reflects productive activity. The total estimated factory-overhead costs are then calculated at this budget level. Finally, the predetermined overhead rate, which will be used to apply factory overhead to products manufactured, is obtained by dividing the estimated overhead costs at the budget level of operations by the budgeted activity base.

The steps in setting a predetermined overhead rate are summarized and illustrated below:

Steps	Example
(1) Establish budget level of operations.....	1,000,000 hr
(2) Estimate overhead costs at budget level.....	\$2,000,000
(3) Calculate predetermined overhead rate by dividing the estimated overhead costs at budget level by budgeted activity base	\$2 per hr

### Factory-overhead allocation and application

A careful distinction should be made between (1) the allocation of factory-overhead costs to service and production departments and (2) the applying of factory overhead to products manufactured, through the use of a predetermined factory-overhead rate. Exhibit 6-1 may help to clarify the distinction.

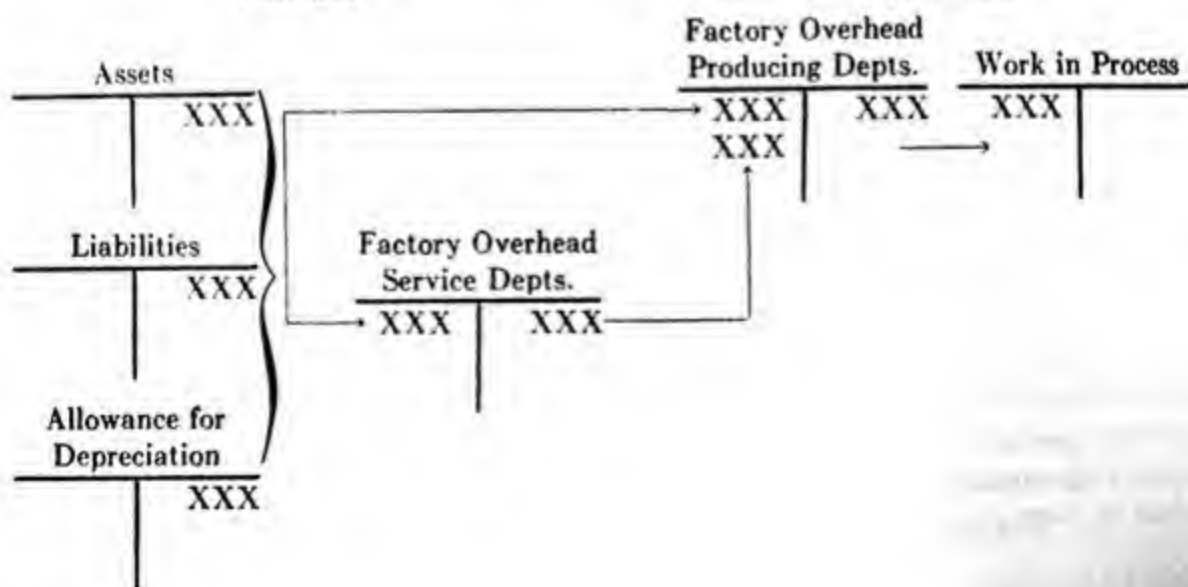
In the preceding chapter, the classifying of incurred factory-overhead costs by departments was referred to as the *allocation* of factory over-

**Exhibit 6-1**

#### Allocation and Application of Factory Overhead

##### Allocation

##### Application



head. Other terms for this procedure are assignment, distribution, and apportionment. The applying of factory-overhead costs to production, the absorption of factory overhead, or the attaching of factory-overhead costs to products is the subject of this chapter and will be referred to as the *application* of factory overhead.

In Exhibit 6-1, step 1 is performed to obtain the departmental costs of the period for control purposes. Step 2 is performed to provide product costs.

### Establishing the budget level of operations

There are three conflicting concepts in regard to the establishment of the budget level of operations for setting predetermined overhead rates. The budget level can be based on the *expected actual* level of activity, *practical capacity*, or *normal capacity*. When the budget is based on expected actual level, it is geared to the sales forecast for the coming fiscal period. When the budget is based on either practical or normal capacity, emphasis is placed on the physical potential of the plant.

The expected actual level of operations is a short-term index. Proponents of this method argue that the intent of the predetermined factory-overhead rate is to estimate the actual overhead for the coming period and that conceptually this can be accomplished only when the overhead rate is based on the expected actual level of activity. It also is contended that capacity concepts involve many controversial aspects and are difficult to establish. This method perhaps has its greatest justification in situations where a company's sales do not fluctuate greatly from period to period or where the method is practiced throughout the industry.

The use of expected actual activity as the basis for establishing predetermined overhead rates has distinct limitations. It may result in sharp differences in the predetermined overhead rate from year to year. This is particularly apt to occur when a company is highly automated and its fixed factory-overhead costs are substantial and its sales tend to fluctuate. As shown below, when sales decline significantly and fixed factory costs are substantial, the predetermined factory-overhead rate rises sharply.

	<i>Period 1</i>	<i>Period 2</i>
Expected sales.....	\$1,000,000	\$600,000
Expected direct labor.....	200,000	120,000
Expected factory overhead:		
Fixed.....	300,000	300,000
Variable.....	100,000	60,000
Total.....	\$ 400,000	\$360,000
Predetermined factory overhead (as a percent of direct labor)....	200%	300%

In the above illustration, it is apparent that the company did not utilize its plant and facilities fully in period 2. Since the predetermined overhead rate is used to charge factory overhead to products manufactured, under this method the products made during period 2 will be charged with 50 percent more factory overhead than in period 1.

What are the effects of this sharp change in the predetermined overhead rate from one period to another? Under this method, the cost of idle facilities is capitalized and included in unsold inventories. As a result, everything else being equal, during a period of business depression the relative cost of inventories on hand would be higher than in periods of prosperity when facilities are being fully utilized.

The inclusion of idle capacity costs in the predetermined overhead rate, under this method, also may have an influence on certain management decisions. For example, if a cost-price relationship existed, product costs and prices would be higher during those periods when idle facilities are present and management is having greatest difficulty in disposing of its products.

When predetermined factory-overhead rates are based on either practical or normal capacity, a long-term viewpoint is adopted. This occurs because the level of activity on which the predetermined overhead rate is based is related to physical capacity and is unaffected by short-term oscillations in sales. Under either of these two methods, the predetermined overhead rate tends to remain constant for relatively long periods of time, provided that there is no expansion or contraction of plant facilities and the rates of indirect labor and the prices of supplies do not change markedly.

There are several different concepts of plant capacity. The capacity of a plant might be viewed from the standpoint of its total maximum output. This is referred to as *theoretical* or *maximum plant capacity*. Since even under ideal manufacturing conditions, some bottlenecks, delays, and other types of production interruptions normally occur, this ideal level of capacity is almost never used to set predetermined overhead rates.

*Practical plant capacity* represents the theoretical capacity less unavoidable time losses. In general, practical capacity tends to be in the range of 70 to 85 percent of theoretical capacity. Practical capacity is fairly commonly used as the level for predetermining factory-overhead costs. The advantage of this method is that the cost of idle facilities is not capitalized in inventories but is treated as a period expense and appears on reports to management.

Perhaps the majority of companies base their predetermined overhead rates on *normal capacity*. Normal capacity gives consideration to a company's long-run ability to *produce* and *sell*. This concept is similar to that of practical capacity, except that consideration also is given to long-term sales trends. Most plants in the long run inevitably cannot avoid having some idle capacity. It should be noted that under this method, not all the cost of idle facilities during a period of relatively low sales

volume is capitalized in inventories. The cost of idle facilities in excess of the normal long-run allowance is written off as a period expense.

Other conceptual and technical difficulties arise when predetermined overhead rates are based on either practical or normal capacity. Plants are rarely perfectly balanced, and the capacities of some departments are apt to be greater than others. Thus, capacity tends to be defined in terms either of individual departments or in terms of a single bottleneck department. Capacity also must be defined in number of shifts. These types of problems can only be resolved by management in the light of the particular conditions existing within a company and industry.

### Determining the variability of factory-overhead costs

After having established the level of activity on which the predetermined factory overhead is to be based, it is necessary to estimate what the factory-overhead costs will be at this budget level. In order to accomplish this, a knowledge is required of the nature of the variability of each factory-overhead cost.

In developing predetermined factory-overhead rates, past experience is modified by future expectations regarding factory-overhead costs. Adjustments in the estimated dollar amounts of factory-overhead costs are made for such factors as inflation in fixed asset replacement costs, expected changes in indirect-labor rates, anticipated increases in the purchase price of indirect materials, and expanded maintenance activity. Such changes, which may not have been anticipated at the beginning of the year when the rates were developed, also may occasionally necessitate a change in rates during the year.

One technique for determining the variability of costs is the *scatter-graph*. The scattergraph discloses the trend line, i.e., regression line, for two sets of data. This is illustrated in Fig. 6-1, based on the costs of supplies used and direct labor shown below. In order for these data to have validity, they must be comparable. For example, the prices of supplies and the rates of direct labor must have been either constant during the period studied or adjusted for such changes that took place.

<i>Period</i>	<i>Average cost of supplies used per month</i>	<i>Average cost of direct labor per month</i>
Quarter of 1963:		
4th	\$10,650	\$250,000
3rd	8,750	200,000
2nd	9,900	225,000
1st	8,650	180,000
Quarter of 1962:		
4th	6,500	100,000
3rd	7,200	150,000
2nd	8,100	175,000
1st	6,250	120,000



Supplies used (in thousands of dollars)

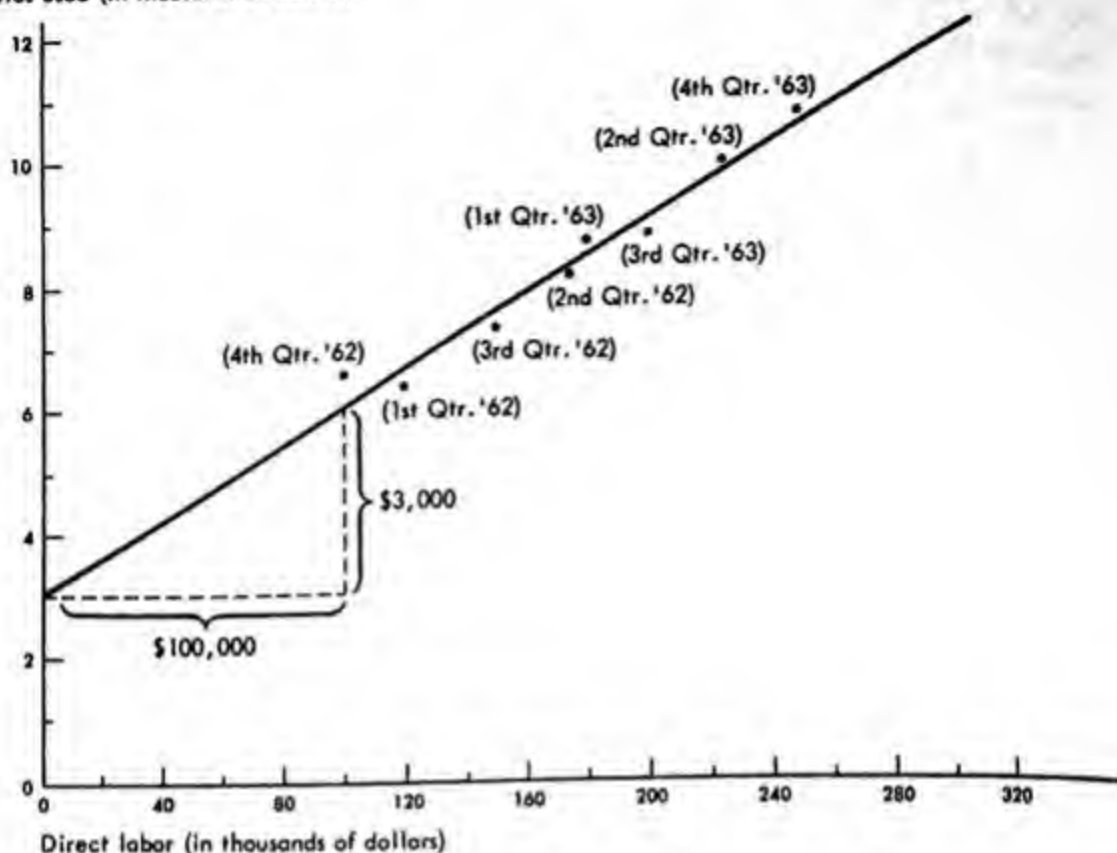


Fig. 6-1 Scattergraph.

In Fig. 6-1, the cost of supplies used has been plotted along the vertical axis and the cost of direct labor, which is the activity base, along the horizontal axis. A line is then fitted to the actual points plotted so that the distances of the points on both sides of the line are approximately equidistant from the line. The fixed element of this cost (\$3,000) is reflected at that point at which the trend line is at 0 sales. The variable element of the cost of supplies is represented by the rate of inclination of the trend line. In the illustration this is equal to approximately 3 per cent of direct labor ( $3,000/100,000$ ).

The scattergraph generally provides sufficiently accurate results for forecasting the variability of costs. If greater precision is desired, the *least-squares method* may be used. This is based upon the equation for a straight line,  $Y = a + bx$ .

If we use the data in Exhibit 6-2 to illustrate this method, the slope of the line or variable cost percentage is equal to

$$\frac{\Sigma xy}{\Sigma x^2} = \frac{544.6}{18,050} = 3.02\%$$



The fixed-cost element is determined as follows:

$$\begin{aligned}
 Y &= a + bx \\
 8.25 &= a + (175)(.0302) \\
 8.25 &= a + 5.285 \\
 2.965 &= a \quad \text{M dollars}
 \end{aligned}$$

where  $Y$  = average monthly cost of supplies used

$a$  = fixed element of supplies used

$b$  = average monthly direct-labor cost

$x$  = slope of line, or variable cost as percent of direct labor

Although statistical analysis provides the most precise measurement of cost variability, in actual practice, a more simplified method generally is used. This is sometimes referred to as *inspection of the accounts*. According to this method, the bulk of overhead costs is classified as being entirely fixed or entirely variable, with estimates of variability as a basis. The rate of variability of those costs which are classified as variable is based upon past cost trends adjusted for future expectations. When this method is used, statistical analysis may be reserved for those few accounts that are believed to be essentially semivariable. The possibility of erroneous estimations of cost variability are of course much greater when this simplified approach is used.

### Exhibit 6-2

#### Illustration of the Least-squares Method

Period	$X$ , direct labor (in M of dollars)	$Y$ , supplies used (in M of dollars)	$x$ , deviation from average direct labor	$y$ , deviation from average supplies used	$x^2$	$xy$
Quarter of 1962:						
1st	\$ 120	\$ 6.25	\$-35	\$-2.00	\$ 3,025	\$110.0
2nd	175	8.10	-0-	- .15	-0-	-0-
3rd	150	7.20	-25	-1.05	625	26.3
4th	100	6.50	-75	-1.75	5,625	131.3
Quarter of 1963:						
1st	180	8.65	+ 5	+ .40	25	2.0
2nd	225	9.90	+50	+1.65	2,500	82.5
3rd	200	8.75	+25	+ .50	625	12.5
4th	250	10.65	+75	+2.40	5,625	180.0
Totals	\$1,400	\$66.00	-0-	-0-	\$18,050	\$544.6
Averages	\$ 175	\$ 8.25				

### Establishing the factory-overhead budget

Having established the budget level of operations and the variability of each factory-overhead cost in the manner described, it is now a simple matter to prepare the factory-overhead budget. The method used is shown in Exhibit 6-3. It will be noted that the budget level of activity is indicated (100,000 direct-labor hours). In order to show how the calculations are made, the degree of variability of each cost is revealed.

### Bases for the predetermined factory-overhead rate

As has been indicated, factory overhead may be subdivided into fixed and variable components. Because of the different behavior of fixed and variable factory overhead with changes in volume, it is useful to segregate the two components and to develop a predetermined variable rate and a predetermined fixed rate. In this discussion, it will be assumed that a factory-overhead rate actually includes a set of rates, i.e., a fixed rate and a variable rate.

The rates are calculated by estimating the total dollars of fixed and variable factory overhead for a certain production activity level and time period and dividing each by some measure of the estimated production

Exhibit 6-3

Calculation of a Factory Department-overhead Budget

Item	Cost variability	Budget level (100,000 hr)		
		Fixed overhead	Variable overhead	Total overhead
Supervision.....	\$16,000	\$16,000	—0—	\$ 16,000
Materials handling....	$\$.07 \times 100,000$	—0—	\$ 7,000	7,000
Office clerical work....	\$4,000	4,000	—0—	4,000
Inspection.....	$\$2,000 + \$.04 \times 100,000$	2,000	4,000	6,000
Overtime and fringe benefits.....	$\$8,000 + \$.16 \times 100,000$	8,000	16,000	24,000
Repairs and maintenance.....	$\$8,000 + \$.10 \times 100,000$	8,000	10,000	18,000
Supplies.....	$\$.25 \times 100,000$	—0—	25,000	25,000
Depreciation—machinery.....	\$5,000	5,000	—0—	5,000
Allocated plant overhead.....	\$24,000	24,000	—0—	24,000
Allocated service department charges.....	$\$16,000 + \$.05 \times 100,000$	16,000	5,000	21,000
Total.....		\$83,000	\$67,000	\$150,000

activity for that time period. This measure of production activity most frequently is an *input measure*, of which the most commonly used are direct-labor hours worked, direct-labor dollars incurred, or machine hours worked. Other input-type measures are quantity of raw materials used, cost of materials used, or some combination of the input-type production activity measures such as prime cost, i.e., cost of direct materials plus cost of direct labor.

When a monetary measure of production activity such as direct-labor dollars or prime cost is used, the rate is expressed as a percentage, since both the numerator and the denominator are dollar amounts. Thus the rate is expressed as a certain percent of prime cost or of direct-labor dollars. When a nonmonetary measure of production activity such as labor hours or machine hours is used, the rate is expressed in dollars (per hour).

There are no firm rules governing the choice of a basis for the factory-overhead rates. The bulk of factory-overhead costs are long-run costs and, for the most part, they are fixed in nature and indirectly related to products or to alternative projects which might be under consideration. A predetermined factory-overhead rate attempts to express factory-overhead costs in a workable form as though they were direct, short-term, and variable in nature. The use of factory-overhead rates enables these costs, which must be recovered in the long run, to be associated with products and projects as well as with departments.

In associating factory-overhead costs with various products, an attempt is made to choose a basis which is common to all products and which is indicative of productive output or of "benefit" to the product. Usually all products require direct-labor hours in their production. This basis for the factory-overhead rate is, therefore, a popular one. Often machines are used extensively in the manufacture of a firm's products. When machines are a more important factor of production than are direct laborers, machine hours may be the appropriate common denominator for the application of factory overhead among products. Similarly, raw materials are common to all products manufactured and sometimes provide the basis for the predetermined factory-overhead rate.

A combination of raw materials and direct labor as a rate base is possible by translating each into dollars. Hence, prime cost, i.e., raw materials cost plus direct-labor cost, is used by some firms. The combination of direct-labor hours and machine hours is a possible factory overhead rate basis expressed in hours.

The nature of a firm's production activities is a major determinant in establishing factory-overhead rates. Some combination of raw materials, direct labor, or machine time should provide a production activity measure which is common to all products. If, however, one, or a combination, of these *input* measures does not result in a satisfactory measure, an *output* measure of number of units of finished product might be adopted. In some cases, where the sales values of finished products are fairly

constant and established and the end products can be identified while in process, relative sales values of individual products might be used as the basis for applying factory overhead among products.

### Departmental rates

A single set of predetermined factory-overhead rates (one fixed rate, one variable rate) might be used for the entire factory. Alternatively, the factory might be departmentalized, and a separate set of rates might be used for each department. In addition, different rates and bases might be used within departments. The decision with respect to the amount of departmentalization for purposes of developing factory-overhead rates and applying factory-overhead costs to production depends in part upon the desired degree of refinement in overhead application. Greater refinement in overhead application is attempted through an increased degree of departmentalization. Greater refinement also is more costly.

Diverse types of production activities within a plant may suggest that for overhead application purposes each type of activity be compartmentalized into departments or cost centers with separate rates for each activity center. Substantially different types of machines, for example, may call for different factory-overhead rates for each. Wide differences in the requirements of labor compared with machines in segments of production activity is also a factor in deciding the number of rates and their bases.

The organizational division for factory-overhead *application* purposes should also be the organizational division for collecting and allocating *incurred* factory overhead. In other words, the incurred costs are collected and allocated by departments, predetermined rates are developed by departments, and factory overhead is applied to products as production takes place in the departments.

### Calculation of the predetermined factory-overhead rate

The calculation and use of the predetermined factory-overhead rate may be explained by an extension of Exhibit 5-2. Assuming that production activity is to be measured in terms of direct-labor hours and that the Darr Company uses an *annual* (rather than a monthly, quarterly, etc.) factory-overhead rate, which is generally the case in practice, the predetermined factory-overhead rate is calculated as shown in Exhibit 6-4.

The rate is a predetermined rate because it is based upon an estimate of the factory-overhead costs *to be incurred* in the future period and an estimate of the direct-labor hours *to be worked* during the future period. These estimates are developed as part of the budgeting process of the firm.

The single plant-wide rate in the Darr Company illustration is \$10 per direct-labor hour. The variable rate is \$2.67 per direct-labor hour and the fixed rate is \$7.33 per direct-labor hour. If departmental variable and fixed rates are used, instead of plant-wide rates, they are, respec-



Exhibit 6-4

THE DARR COMPANY

Calculation of Predetermined Factory-overhead Rate

Estimated (budgeted) factory-overhead for the entire plant for the year:

	Dept. A	Dept. B	Total
Production department overhead:			
Variable .....	\$ 16,400	\$ 8,000	\$ 24,400
Fixed .....	10,000	8,000	18,000
Factory office overhead (allocated):			
Variable .....	1,000	1,000	2,000
Fixed .....	5,000	5,000	10,000
Maintenance dept. overhead (allocated):			
Variable .....	2,000	1,000	3,000
Fixed .....	8,140	4,460	12,600
Plant overhead (allocated):			
Variable .....	12,000	12,000	24,000
Fixed .....	54,950	51,050	106,000
Total overhead .....	\$109,490	\$90,510	\$200,000
Total variable .....	\$ 31,400	\$22,000	\$ 53,400
Total fixed .....	\$ 78,090	\$68,510	\$146,600

Estimated (budgeted) direct-labor hours to be worked during the year:

Department A .....	10,000
Department B .....	10,000
Total .....	20,000

$$\$200,000 \div 20,000 \text{ direct-labor hr} = \$10 \text{ per direct-labor hr}$$

$$\text{Variable} = \$53,400 \div 20,000 \text{ hr} = \$2.67$$

$$\text{Fixed} = \$146,600 \div 20,000 \text{ hr} = \$7.33$$

Dept. A rate:

$$\text{Variable} = \$31,400 \div 10,000 = \$ 3.14$$

$$\text{Fixed} = \$78,090 \div 10,000 = \$ 7.809$$

$$\underline{\$10.949}$$

Dept. B rate:

$$\text{Variable} = \$22,000 \div 10,000 = \$2.20$$

$$\text{Fixed} = \$68,510 \div 10,000 = \$6.851$$

$$\underline{\$9.051}$$

tively, \$3.14 and \$7.809 for Department A and \$2.20 and \$6.851 for Department B.

In Exhibit 6-4, all factory overhead has been classified either as fixed or variable. In reality, some items are semivariable. Most of these items have been put into the fixed classification, because over the 10,000 to 12,000 direct-labor-hour activity range it has been determined that these costs do not vary.



## Application of predetermined factory overhead

### Use of the predetermined factory-overhead rate

As production activity takes place during a period, i.e., as direct-labor hours are worked, factory-overhead costs are applied to, or absorbed by, production. That is, factory-overhead costs are attached to, or applied to, products on the basis of the direct-labor hours which are used in the manufacture of the product.

Assume in the case of the Darr Company that the plant works 1,800 direct-labor hours during the month of January. Using a plant-wide rate, applied factory overhead would amount to \$18,000 (1,800 direct-labor hours  $\times$  \$10 per direct-labor hour). In other words, the factory overhead element of the cost of goods manufactured during January is \$18,000. Assuming that 1,000 units of product were produced, this would amount to \$18 per unit of product completed.

In the cost accounts, the entry to apply factory overhead is a debit to Work in Process and a credit to the Factory Overhead account (or accounts), for \$18,000. In practice, instead of crediting Factory Overhead, generally a different account called *Factory Overhead Applied* is credited. If this method is used, the Factory Overhead Applied account acts as an offset to the Factory Overhead account. When a separate Factory Overhead Applied account is used, it is easier to keep the Factory Overhead account in agreement with its subsidiary ledger accounts.

In Exhibit 6-4, the Darr Company keeps a Factory Overhead account for Department A and one for Department B. Two predetermined departmental overhead rates might therefore be used instead of a single rate for the entire factory. The rates would be as follows:

Dept. A: Variable rate, \$3.14; fixed rate, \$7.809

Dept. B: Variable rate, \$2.20; fixed rate, \$6.851

Assuming that each department worked half (900) of the total direct-labor hours (1,800) worked in the factory in January, applied factory overhead would be \$9,854.10 for Department A and \$8,145.90 for Department B. The entry to record this application would be:

Work in Process—Dept. A .....	9,854.10	
Work in Process—Dept. B .....	8,145.90	
Factory Overhead Applied—Dept. A .....		9,854.10
Factory Overhead Applied—Dept. B .....		8,145.90

Single work-in-process and factory-overhead control accounts might be used with the departmental breakdowns being maintained in a subsidiary ledger. Such an arrangement is not particularly efficient unless the number of departments is substantial. In the case of Factory Overhead, such an arrangement would indicate the use of *two* subsidiary ledgers—one to show classification by department and one to show

classification by object of expenditure. The two classifications could be combined into one subsidiary ledger through the appropriate use of account titles such as Dept. A—Indirect Labor and Dept. B—Indirect Labor.

### Service department billing rates

The costs of operating factory service departments, such as a maintenance department or a power plant, may be applied to products manufactured, in one of two ways:

1. As has been indicated previously, actual service department costs may be accumulated and allocated to producing departments on some basis at the end of each month.

2. A predetermined billing rate may be established for each service department on the basis of an annual budget in the same manner as for producing departments, as shown below:

Predetermined service department billing rate

$$= \frac{\text{budgeted service department costs}}{\text{budgeted level of service activity}}$$

Referring to Exhibit 6-4, the predetermined billing rate for the maintenance department of the Darr Company would be 78 cents per hour (\$15,600/20,000 hr). At the close of each month, the Maintenance Department account would be credited and the factory overhead accounts of the producing departments charged with an amount based on the actual activity multiplied by the predetermined maintenance department billing rate. For example, if during January 900 hours were worked in both Department A and Department B, each department's Factory Overhead account would be charged with \$702 and the Maintenance Department credited with \$1,404.

A variation of this method sometimes is used in practice, where instead of charging the factory overhead accounts of the producing departments, service department costs are applied directly to Work in Process. When this variation is used, service department costs are not considered in establishing predetermined overhead rates for production departments.

The use of predetermined billing rates for service departments has certain advantages. It provides a basis for controlling service department costs, particularly if a fairly large portion of these costs are variable and if dual rates are used, one variable and one fixed. However, in practice service department costs tend to be predominantly fixed. Difficulty also is encountered in measuring the activity of service departments.

Ideally, service department costs should be charged to the using production departments on the basis of the cost of the services provided. Power costs, for example, would be charged to production departments on some such basis as metered usage, and maintenance costs could be charged on the basis of the time spent and supplies used in maintaining

each production department. The ideal seldom can be attained for two major reasons:

1. Measures of services provided are difficult to define realistically. As an example, the service provided to production departments by the factory office in maintaining payrolls and cost records is virtually impossible to measure.

2. Even if service measurements can be defined, the clerical cost of measurement exceeds the value of the measurement precision obtained.

For simplicity, these two problems are avoided by assuming that those production departments with the greatest amount of production activity utilize the greatest amounts of service provided by the service departments. Under this assumption, direct-labor hours or machine hours or some other measure of productive activity is used as the basis for the billing rate for service department costs.

### Factory-overhead rate structure and cost averaging

In addition to the two alternatives of utilizing a single overhead rate for the plant as a whole, or of utilizing a separate rate for each production department into which all factory-overhead costs are collected, another alternative is possible: a separate rate might be used for the application of overhead costs which are *direct* with respect to each production department, to each service department, and only to the plant as a whole (such as building depreciation).

When production department rates, service department rates, and a plant-overhead rate are used, the need for *allocating* service department costs and plant-overhead costs to the production departments is avoided. For the Darr Company illustration, this is most easily understood by referring to Exhibit 5-1 in which service department and plant-overhead costs have not been allocated to production departments.

Using the detail of the same given budgetary data for the Darr Company, the overhead rates would be as follows:

Dept. A:	$\$26,400 \div 10,000$ direct-labor hr	= \$2.64
Dept. B:	$\$16,000 \div 10,000$ direct-labor hr	= \$1.60
Factory office:	$\$12,000 \div 20,000$ direct-labor hr	= \$ .60
Maintenance dept.:	$\$15,600 \div 20,000$ direct-labor hr	= \$ .78
Plant overhead:	$\$130,000 \div 20,000$ direct-labor hr	= \$6.50

Thus, for production activity in January of 900 direct-labor hours worked in Department A and 900 direct-labor hours in Department B, factory overhead attached to products would consist of:

Factory overhead—Department A	\$ 2,376
Factory overhead—Department B	1,440
Factory overhead—factory office	1,080
Factory overhead—maintenance department	1,404
Factory overhead—plant	11,700
Total	<u>\$18,000</u>

The entry to record this would be as follows:

Work in Process—Dept. A.....	9,468	
Work in Process—Dept. B.....	8,532	
Factory Overhead Applied—Dept. A.....		2,376
Factory Overhead Applied—Dept. B.....		1,440
Factory Overhead Applied—Factory Office.....		1,080
Factory Overhead Applied—Maintenance Dept.....		1,404
Factory Overhead Applied—Plant.....		11,700

For production of 1,000 units of product, the factory-overhead cost per unit of finished product would be:

Department A factory overhead.....	\$ 2.376
Department B factory overhead.....	1.44
Factory office overhead.....	1.08
Maintenance department overhead.....	1.404
Factory overhead—plant.....	11.70
Total.....	<u>\$18.00</u>

By assuming that production activity is identical in both production departments, this illustration is designed so that all illustrated methods of calculating and applying factory overhead give identical unit product costs. Where this assumption is not made, different costs result from the alternatives of using (1) a single factory-overhead rate for the entire factory, (2) a separate rate for each production department in which all factory-overhead costs are collected, or (3) a separate rate for the factory-overhead costs directly traceable to each production and service department and the general plant.

A preference for any of these three methods depends largely upon the extent to which averaging is desired or tolerated. A single rate for the entire factory is the most extreme average rate. There is less averaging in the use of different rates for each production department. Where there are large differences among production departments in production activity or in the factory-overhead costs associated with production departments, a single, blanket overhead rate for the entire factory tends to ignore these differences by the averaging process.

In a similar manner, the use of an individual overhead rate for each production department, service department, and the general plant tends to average out differences in the extent to which the service departments and the general plant contribute to the production in each production department. Such differences can be prevented from being "averaged out" by allocating service department and plant-overhead costs to production departments and then using separate rates for each production department (two rates in the case of the Darr Company).

The differences which may result from the different predetermined factory-overhead rate methods can be illustrated by assuming that 1,100 (rather than 900) of the total direct-labor hours were worked in Department A and 700 (rather than 900) were worked in Department B. The following results are obtained:



**Method 1—Single Factory Rate:**

Work in Process—Dept. A.....	11,000	
Work in Process—Dept. B.....	7,000	
Factory Overhead Applied.....		18,000
(Total applied overhead: \$18,000)		

**Method 2—Separate Rates for Each Production Department:**

Work in Process—Dept. A.....	12,043.90	
Work in Process—Dept. B.....	6,335.70	
Factory Overhead Applied—Dept. A.....		12,043.90
Factory Overhead Applied—Dept. B.....		6,335.70
(Total applied overhead: \$18,379.60)		

**Method 3—Separate Rates for Factory-overhead Costs Which Are Direct with Respect to Production Departments, Service Departments, and the General Plant:**

Work in Process—Dept. A.....	11,572	
Work in Process—Dept. B.....	6,636	
Factory Overhead Applied—Dept. A.....		2,904
Factory Overhead Applied—Dept. B.....		1,120
Factory Overhead Applied—Factory Office		1,080
Factory Overhead Applied—Maintenance		
Dept.....		1,404
Factory Overhead Applied—Plant.....		11,700
(Total applied overhead: \$18,208)		

The resulting product costs per unit under each method, assuming that 20 units of product X result from Department A and that 10 units of product Y result from Department B, are as follows:

Method	Product X	Product Y
1	\$550.00	\$700.00
2	602.20	633.57
3	578.60	663.60

The range of cost of Product X is approximately \$50, or nearly 10 percent. The range of cost of product Y is about \$70, or approximately 10 percent. When pricing is closely related to cost, a 10 percent difference may be significant in competitive pricing situations. An understanding of the effect of the various methods in any particular firm situation is gained through analysis and experience.

**Applied factory overhead in the cost accounts**

The Darr Company cost accounts of Exhibit 5-2 would appear as shown in Exhibit 6-5 after the application of factory overhead, assuming two separate rates, one for each production department, with 1,100 hours



Exhibit 6-5

THE DARR COMPANY  
Incurred and Applied Factory Overhead  
In the Accounts

Factory Overhead— Production Dept. A		Factory Overhead Applied— Production Dept. A		Work in Process— Dept. A	
Incurred:		Applied:		Applied:	Goods
\$9,232		\$12,043.90		\$12,043.90	finished:
					\$6,021.95
					Ending
					inventory:
					\$6,021.95
Factory Overhead— Production Dept. B		Factory Overhead Applied— Production Dept. B		Work in Process— Dept. B	
Incurred:		Applied:		Applied:	Goods
\$7,418		\$6,335.70		\$6,335.70	finished:
					\$3,167.85
					Ending
					inventory:
					\$3,167.85

worked in A and 700 hours worked in B. One-half of the production in each department was finished. (The costs represent the factory-overhead costs only.)

In the cost accounts of the Darr Company presented in Exhibit 6-5, factory overhead is *overapplied* in Department A and *underapplied* in Department B, as is indicated by examining the Factory Overhead and Factory Overhead Applied accounts. The overapplied balance in Department A is \$2,811.90, and the underapplied balance in Department B is \$1,082.30. Underapplied and overapplied balances are called *variances*, because they represent the variation of actual incurred costs from estimated or predetermined costs.

## Overhead variance analysis

### Under- or overapplied factory overhead

Factory overhead incurred might be viewed as a pool of accumulated costs which are siphoned off to goods manufactured through the technique of overhead application. During a time period such as a month a greater amount of these costs might be accumulated in the pool (incurred) than is siphoned off (applied) and vice versa. Thus at the end of any time period there may be an over- or underapplied balance.

Under- or overapplied factory-overhead balances which exist at the end of any month may be due to one or more of several factors. One factor is that of poor estimates used in calculating the predetermined factory-overhead rate. Other factors include the following:

1. Factory-overhead costs actually incurred may be greater or less than the budgeted overhead costs (used in calculating the normal overhead rate), adjusted to the actual level of operations. This is an indication of having spent too much money or of having "economized." Variable overhead costs are the major cause of this variance.

2. Production activity may be greater or less than necessary to absorb the month's share of factory overhead. This is an indication of efficiency or inefficiency or of idle time or overtime. This variance relates to fixed costs.

3. Under- or overapplied factory overhead may result from seasonal factors such as long and short calendar months and the seasonal nature of certain incurred factory-overhead expenses. Both variable and fixed costs may cause this variance. Seasonal factors cancel out as the yearly cycle is completed.

Overapplied factory overhead has the qualities of a gain or reduction in cost, as do all nominal accounts with credit balances. Conversely, underapplied factory overhead is in the nature of a loss or addition to cost similar to other losses and expenses.

### The budget variance

The under- or overapplied factory-overhead variance may be segregated into at least two major variances, the budget and volume variances. An expansion of this subject is presented in later chapters on standard costs.

The *budget* or *spending* variance represents the difference between the actual overhead and the budgeted overhead adjusted to the actual level of operations. This variance indicates the difference between the *actual* expenditures (and accruals) and the budgetary estimates of what *should* have been spent. The budget variance essentially relates to variable overhead costs, since fixed overhead costs normally do not vary to any appreciable extent from the budget. However, if the actual fixed overhead costs differ from the budget, e.g., increases in tax or insurance rates, or more depreciation due to facility acquisitions, this also results in a budget variance.

The calculation of the budget and volume variances may be illustrated by reference to the data for the Mozart Company contained in Exhibit 6-6. As indicated below, there was an underapplication of factory overhead of \$13,000.

Overhead applied to production (90,000 hr @ \$2).....	\$180,000
Actual overhead incurred.....	193,000
Underapplication of overhead.....	<u>\$ 13,000</u>

The budget variance may be calculated in either of two ways, as shown below:

(1)	
Actual overhead.....	\$193,000
Overhead budget adjusted to actual level.....	190,000
Budget variance.....	<u>\$ 3,000</u>
(2)	
Actual variable budget rate $\times$ actual level of activity + actual fixed overhead ( $\$1.0222 \times 90,000 + \$101,000$ ).....	\$193,000
Budgeted variable rate $\times$ actual level of activity + budgeted fixed overhead ( $\$1 \times 90,000 + \$100,000$ ).....	190,000
Budget variance.....	<u>\$ 3,000</u>

The overhead budget variance sometimes is described as the *controllable* variance. Actually this variance may be only partly controllable by lower levels of management. This depends on the composition of the variance. For example, as shown below, the budget variance of the Mozart Company consists of four elements: supplies, indirect labor, repairs (all variable), and allocated service department charges (fixed). The budget variance related to the variable costs may be due to rises in the rates of indirect labor and prices of supplies and repairs which are not controllable by factory supervisors. The quantities of these costs

Exhibit 6-6

THE MOZART COMPANY  
Data for Calculation of Overhead Variances

	Budget level (100,000 hr)		Actual level (90,000 hr)		Budget adjusted to actual
	Amount	Rate	Amount	Rate	
Variable:					
Supplies.....	\$ 30,000	\$ .30	\$ 28,000	\$ .3111	\$ 27,000
Indirect labor.....	50,000	.50	49,000	.5444	45,000
Repairs.....	20,000	.20	15,000	.1667	18,000
Total variable.....	\$100,000	\$1.00	\$ 92,000	\$1.0222	\$ 90,000
Fixed:					
Supervision.....	20,000	\$ .20	20,000	\$ .2222	\$ 20,000
Depreciation—machinery.....	15,000	.15	15,000	.1667	15,000
Allocated plant overhead.....	45,000	.45	45,000	.50	45,000
Allocated service charges.....	20,000	.20	21,000	.2333	20,000
Total fixed.....	\$100,000	\$1.00	\$101,000	\$1.1222	\$100,000
Total overhead.....	\$200,000	\$2.00	\$193,000	\$2.1444	\$190,000

used, however, are to a much greater extent controllable by factory supervision. The budget variance arising from allocated service department costs also generally is not controllable by departmental supervisors.

	Actual	Budget adjusted to actual level	Budget variance
Supplies .....	\$ 28,000	\$ 27,000	\$(1,000)
Indirect labor .....	49,000	45,000	(4,000)
Repairs .....	15,000	18,000	3,000
Allocated service charges ..	21,000	20,000	(1,000)
Total .....	\$113,000	\$110,000	\$(3,000)

### The volume variance

The *volume* variance is caused by an under- or overutilization of plant and facilities, as compared to the budget level of operations. It is represented by the difference between the budgeted fixed factory-overhead costs and fixed factory-overhead costs applied to production. Only when the actual level of activity is identical with the budget level does the applied fixed factory overhead equal the budgeted fixed factory overhead. The volume variance may be calculated in at least two ways, as shown for the Mozart Company below.

(1)

Budgeted fixed factory overhead .....	\$100,000
Fixed factory overhead applied to production (90,000 × \$1) .....	90,000
Volume variance .....	<u>\$ 10,000</u>

(2)

Actual budget level of activity, hr .....	100,000
Budgeted level of activity, hr .....	90,000
Idle capacity, hr .....	10,000
Fixed factory-overhead rate .....	\$ 1 <u>\$10,000</u>

It should be noted that the two variances combined are equal to the total under- or overapplication of overhead, as shown below for the Mozart Company.

Budget variance .....	\$ 3,000
Volume variance .....	10,000
Underapplication of overhead .....	<u>\$13,000</u>

### Disposition of under- or overapplied factory overhead

At the end of each month, any under- or overapplied balance in the factory-overhead accounts may be transferred to an account called *Under-*

or *Overapplied Factory Overhead*. This will then be shown on interim balance sheets as either a deferred charge or deferred credit. The reason for this treatment is that in theory an underapplication of factory overhead during one month will be offset by overapplications in succeeding months. Thus, an underapplication represents an excess of incurred overhead costs which are applicable to the production of succeeding months.

The disposition of under- or overapplied factory overhead at the end of the year depends on the causes of the variances. If the variance is due to errors in calculating the normal overhead rate or to conditions unrelated to operating efficiency, such as those caused by differences in the prices of indirect materials or rates of indirect labor, then the variance should be prorated over the Work in Process account, Finished Goods account, and Cost of Sales account. In effect this procedure retroactively adjusts the predetermined rate from the estimate to the actual. All accounts affected by this difference between the predetermined and actual overhead rate also must be adjusted. This is illustrated below:

	<i>End-of-the-year balances (before adjustment*)</i>	<i>End-of-the-year balances (after adjustment)</i>
Underapplied factory overhead . . . . .	\$ 8,000	-0-
Work in Process . . . . .	40,000	\$ 40,400
Finished Goods . . . . .	60,000	60,600
Cost of Sales . . . . .	700,000	707,000.

\* Basis of adjustment 8,000/800,000, or 1%.

If the overhead variance is caused by factory inefficiency or by operations above or below the normal level, the variance should be charged to Cost of Sales. There is no justification for increasing the cost of inventories for the cost of inefficiency or idle capacity. This method of disposing of the under- or overapplied factory-overhead balance is widespread in practice and often is used regardless of the nature of the overhead variance. The reasons for this are that (1) some companies do not attempt to determine the causes of the overhead variance, (2) the amount of the under- or overapplied factory overhead may be too small in relation to the accounts affected to warrant proration, and (3) work-in-process and finished goods balances tend to be minor in relation to cost of sales. On the income statement, for external purposes, underapplied factory overhead is reported as follows:

Sales . . . . .		XXX
Cost of sales . . . . .	XXX	
Add: Underapplied factory overhead . . . . .	XXX	XXX
Gross profit . . . . .		XXX



## Control of factory-overhead costs

Control of factory-overhead costs is best achieved by means of the variable overhead budget, also known as the flexible or adjusted budget. A *variable budget* indicates the overhead costs *allowed* at the actual level of operations. The variable budget provides a basis for comparing the actual overhead costs incurred with the budgeted costs adjusted to the actual level of operations.

Variable budgets may be contrasted with fixed budgets, also referred to as planning or static budgets. A *fixed budget* contains no adjustment of cost allowances for the activity level actually reached during the period, even though this level may be different from that on which the budgeted overhead costs were based. The fixed budget, which is commonly used for planning and for establishing the predetermined factory-overhead rate, typically is constructed for a 1-year period. Some firms, which do not employ variable budgets, merely divide the annual fixed budget by 12 to obtain the monthly budgets used for control purposes. However, this will not result in effective cost control, except where the level of activity of the organizational unit being budgeted remains relatively constant throughout the year. The merit of using variable budgets, rather than fixed budgets, for control purposes is apparent when one recalls that some overhead costs are a function of activity, i.e., that they vary with activity, while other overhead costs are a function of time.

Two general approaches may be used to develop a variable factory-overhead budget: (1) range of activity method and (2) fixed plus variable rate method.

### Range of activity method of setting variable budget

The range of activity method shown in Exhibit 6-7 is the simpler variable budget method conceptually, but perhaps the most difficult to construct in practice. In Exhibit 6-7 the budget allowances for both variable and fixed factory-overhead costs are shown for various activity levels, measured in direct-labor hours.

These allowances are developed from a study of factory-overhead cost levels experienced at various activity levels reached in the past. Actual cost data of past periods are adjusted for changes in general economic conditions and for desired improved efficiencies. These adjustments plus the fact that the firm may never have operated at some particular operating levels make this method difficult in practice.

The budget is used for cost control by locating the column which contains the allowances for the activity level reached during the current period. Actual costs incurred during the period then are compared with the allowances, and variations of actual from budget are investigated.

Assume, for example, that 6,000 direct-labor hours were worked during the current period. The total factory-overhead budget is \$4,970, con-

**Exhibit 6-7**

**Range of Activity Method of Setting Variable  
Budget for Factory Overhead**

Cost	Levels of productive activity (in labor hours)					
	-0-	2,000	4,000	6,000	8,000	10,000
Productive supplies.....	\$ 0	\$ 160	\$ 320	\$ 480	\$ 640	\$ 800
Machine repairs.....	100	260	420	580	820	1,100
Power.....	100	180	250	310	360	400
Depreciation of machinery.....	2,000	2,000	2,000	2,000	2,000	2,000
Supervision.....	800	800	1,600	1,600	2,400	2,400
Total.....	\$3,000	\$3,400	\$4,590	\$4,970	\$6,220	\$6,700

sisting of budget allowances for each of the cost items. Actual machine repairs of, let us say, \$660 would be compared with the budget allowance of \$580. The actual cost exceeded the budget by \$80. The cause will be determined and corrective action taken if the cause is controllable.

The variable budget for factory overhead in Exhibit 6-7 contains fixed, variable, and semivariable costs. For example, depreciation of machinery is fixed, productive supplies cost is variable, and machine repairs, power, and supervision costs are semivariable. Notice that the variable and fixed elements of these semivariable costs are not segregated in Exhibit 6-7. This method may result in a more accurate budget allowance, because there is no assumption made that variable costs are linear over ranges of output. However, this advantage is offset by the need to interpolate if the actual level lies between two specific budget levels. When interpolation becomes necessary, it is based on the assumption that a linear relationship exists between these two budget levels.

**Fixed plus variable rate method of setting variable budget**

The fixed plus variable rate method is illustrated in Exhibit 6-8. The basic idea of this method is that for any activity level, measured in this case in direct-labor hours, the budget allowance will be a certain dollar amount for fixed cost elements plus a certain dollar amount for variable cost elements. The allowance for variable costs is obtained by multiplying direct-labor hours worked during the period by the variable rate per hour.

Assume, for example, that 6,000 direct-labor hours were worked. The total factory-overhead budget would amount to \$3,000 + 6,000 hours  $\times$  \$.26, or \$4,560. Actual machine repairs of, for example, \$660 would be compared with the budget allowance of \$700, (\$100 + 6,000 hours  $\times$  \$.10) to indicate a cost saving of \$40.

**Exhibit 6-8****Fixed Plus Variable Rate Method of Setting Variable Budget for Factory Overhead**

<i>Cost</i>	<i>Fixed amount</i>	<i>Variable rate per labor hour</i>
Productive supplies.....	-0-	\$ .08
Machine repairs.....	\$ 100	.10
Power.....	100	.03
Depreciation of machinery.....	2,000	-0-
Supervision.....	800	.05
Total.....	\$3,000	\$ .26

The fixed plus variable rate method emphasizes the variability of costs by segregating fixed and variable cost elements. Exhibit 6-8 also assumes that variable costs vary directly and proportionately (i.e., in a linear fashion) with activity. Ordinarily this is not the case.

For the ideal method, the meritorious features of these two methods should be combined. Specifically, the fixed and variable cost elements should be determined at various operating levels. Thus, a budget similar to Exhibit 6-8 would be developed for the several levels of output in Exhibit 6-7. Variable budget techniques also may be used to control selling and administrative expenses.

**The factory overhead control report**

The relationship between the fixed budget, used for planning purposes, and the variable budget, used for control purposes, may be better understood by referring back to Exhibit 6-3 and comparing it with Exhibit 6-9.

In order to establish the predetermined factory-overhead rate in Exhibit 6-3, all factory-overhead costs were included in the fixed budget, regardless of the variability and controllability of these costs. Two points should be noted in regard to Exhibit 6-9: (1) only certain costs included in the fixed budget (Exhibit 6-3) appear in the control report (Exhibit 6-9), and (2) the budgeted costs shown on the control report have been adjusted to the actual level of operations (90,000 hours).

In Exhibit 6-9, only those overhead costs which are controllable by the supervisor of the department are included on the control report. Three categories of overhead costs have been excluded: (1) direct departmental overhead costs of a fixed nature, i.e., supervision, office clerical, and depreciation of machinery, (2) allocated plant overhead, and (3) allocated service department charges. It generally serves no purpose to include costs in a control report over which the supervisor can exercise no real control.

Exhibit 6-9

## Departmental Overhead Control Report

Item	Actual level (90,000 hr)		
	Variable budget allowance adjusted to actual level	Actual overhead costs	Budget variance
Materials handling.....	\$ 6,300	\$ 6,200	\$ 100
Inspection.....	5,600	5,400	200
Overtime and fringe benefits.....	22,400	22,000	400
Repairs and maintenance.....	17,000	18,300	(1,300)
Supplies.....	22,500	24,800	(2,300)
Totals.....	\$73,800	\$76,700	\$(2,900)

## Difficulties encountered in controlling overhead cost

Technically, all factory-overhead costs are controllable by the highest level of the firm's management because of the final responsibility and authority which is held by that group. Certain authority, accompanied by accountability, is delegated to lower levels of management for controlling certain costs within their jurisdiction.

Generally speaking, more of the firm's factory-overhead costs become controllable as one views management from the lowest level to the highest; conversely, fewer factory-overhead costs are controllable as one goes from the highest level to the lowest level of management. The use of indirect materials, for example, may be controllable by a departmental foreman; the cost of the depreciation of the factory building, on the other hand, may not be controllable by him because of the fact that decisions regarding building purchases are made at top-management level.

Many factory-overhead costs are jointly controllable by the production department and some other department or function in the firm. For example, a particular production department frequently can control to some extent the use of indirect labor in that department; the price of labor, however, often is determined by the union contract negotiated by top-level management.

As another example, a particular production department can control the use of indirect materials used in that department; the price per unit of indirect materials, on the other hand, may be established by the purchasing function. Similarly, losses caused by idle time in the factory may be due to breakdowns in the production department, or they may be caused by lack of sales orders on the part of the sales department.

It should be emphasized that for management control purposes, it is essential that attention be centered on those costs which are controllable by the individual in charge of the department. That is, in appraising the



performance of a department and of the individual in charge of that department, upper levels of management should hold the departmental manager responsible only for those costs which he can control by reason of the nature of these costs and the departmental manager's authority and responsibility. Generally, the controllable costs for a department are those which are direct with respect to that department. Controllable costs also tend to be variable with activity. In general, factory-overhead costs tend to be fixed or semifixed, indirect with respect either to products or to departments, and uncontrollable by lower levels of management. As business firms become larger and the processes of product development and production become more complex, greater investment in more expensive talent and equipment is necessary.

With increased union strength, increased efforts to bring about a guaranteed or stabilized annual wage for labor, and increased automation, more factory costs become fixed, indirect with respect to product, and controllable only by top management, which incurs them. The accompanying costs of repairs and maintenance, on the other hand, are controllable by lower levels. Such factors increase the relative importance of factory overhead as an element of manufacturing cost and also increase the difficulties associated with accounting for and controlling factory-overhead costs.

In addition to the fact that the relatively greater magnitude of fixed costs moves controllability to a higher management level, the control of costs is made more difficult because of lessened opportunity to make decisions which will alter the amount of these costs. This lessened opportunity to control costs results from the fact that fixed costs are long-term costs; i.e., they are the result of relatively infrequently made financial outlays which will not be recovered for a relatively longer time than is the case with direct or variable costs. With these fixed costs, the opportunity to control their magnitude is available only at the time of the decision to make or not to make the financial outlay. Management emphasis thus tends to switch from the control of long-run costs to capital management and capital budgeting.

### *Internal profit measurement and the factory-overhead rate*

The predetermined or normal factory-overhead rate discussed up to this point has been a cost rate. By adding to the normal overhead rate a normal rate of profit, a technique is provided to measure the profit generated by a department as a contribution to the total firm profit. This technique is known as internal profit measurement. Through the use of this technique, the firm's profit motivation is forced into the lower levels of management.

Exhibit 6-10 indicates how this technique might work for the Marple Company. For simplicity, no inventory is assumed in the single depart-



Exhibit 6-10

THE MARPLE COMPANY  
Internal Profit Measurement  
Process X

Incurring factory overhead	18,000	Applied: 1,800 hr $\times$ 13 =	23,400
Materials		Materials	
Labor		Labor	

mental account, Process X. A normal factory-overhead rate of \$10 per direct-labor hour plus a normal profit rate of \$3 per direct-labor hour are used for application purposes. Direct-labor hours worked amount to 1,800. The \$3 rate might be determined by reference to the selling price of the output of Process X or by internal negotiation such as might be found in decentralized operations. The basis for the rate in this illustration, however, is direct-labor hours.

The manager of Process X is charged with \$18,000 of factory-overhead costs. He is relieved of accountability for these costs and is credited with a normal amount of profit earned as productive labor hours are worked in the production of products. Applied factory overhead and the earned profit amount to \$23,400.

The credit balance of the Process X account is \$5,400, which is 1,800 hours  $\times$  \$3 normal profit. This amount may be regarded as the value added by Process X, or as the contribution of Process X to the profits of the firm as a whole. The performance of the manager of Process X is measured by the credit balance of the account as a percent of the normal factory-overhead cost. It should be noted that either an underapplication or an "overincurrence" of factory overhead reduce the value added, or balance, of the account. In the example, the normal profit is 30 percent of normal factory overhead ( $\$5,400 \div \$18,000$ ).

The value added by the process can be diminished or enhanced through an operating situation in which under- or overapplied factory overhead results. For example, assume that incurred factory-overhead costs amounted to \$20,000 rather than \$18,000. The credit balance of the account would then be only \$3,400. The unfavorable variance of \$2,000 resulting from the incurring of more factory overhead than normal has reduced the amount of value added by \$2,000. In a similar manner, favorable operating conditions (overapplied factory overhead) increase the amount of value added by the process.

To be effective as a measure of supervisory efficiency, the direct-labor hours worked must be *productive* hours; i.e., they must result in output of good units of product. The use of normal or standard direct-labor hours allowed for units of product produced is a better basis for factory-overhead application and internal profit measurement. Standard costs are discussed in later chapters.

For simplicity, the normal profit rate in Exhibit 6-10 is based upon factory overhead. The rate might better have been based upon normal or standard cost of product produced, including all three elements of cost—materials, direct labor, and factory overhead. Such a basis provides the departmental manager with the possibility of offsetting an under-application of factory overhead, for example, with a saving in materials or direct-labor cost.

In measuring the department's performance in this case, the attainment of less than capacity volume affects the departmental profit results. Where this is beyond the control of the department manager, an allowance should be made for this factor in measuring his performance.

### *Problems and cases*

- 6-1 *Reasons for predetermining overhead.* Why is it desirable to have factory-overhead costs available prior to their incurrence?
- 6-2 *Fixed and variable overhead rates.* Why is it desirable to divide the predetermined overhead rate into fixed and variable components?
- 6-3 *Selection of base for overhead rate.* What is the principal criterion used in selecting a base for predetermined overhead rates?
- 6-4 *Departmental and plant rates.* What are the advantages of departmental overhead rates as compared with a single rate for the entire plant?
- 6-5 *Procedure for establishing overhead rates.* List the steps to be followed in establishing a predetermined factory-overhead rate.
- 6-6 *The Factory Overhead Applied account.* What is the advantage of having a separate account called Factory Overhead Applied?
- 6-7 *Under- or overapplied overhead.* What are the causes of under- or overapplied factory overhead?
- 6-8 *Disposition of over- or underapplied overhead.* How may the over- or under-applied factory overhead account be treated?
- 6-9 *Normalizing overhead costs.* What are the advantages of normalizing factory-overhead costs?
- 6-10 *Service department costs.* How may service department costs be allocated to products?
- 6-11 *Difficulties in establishing service department rates.* What difficulties are encountered in establishing predetermined service department billing rates?
- 6-12 *Overhead budgets.* Contrast the fixed and variable overhead budgets.
- 6-13 *Types of variable budgets.* Contrast the range of activity and the fixed plus variable types of variable budgets.
- 6-14 *Determining variability of overhead costs.* Describe three ways of determining the variability of overhead costs.

- 6-15** *Overhead costing.* Complete the following blank spaces:
1. Factory-overhead costs are made available prior to their being incurred by means of \_\_\_\_\_.
  2. The use of predetermined overhead rates is more essential in \_\_\_\_\_ than in \_\_\_\_\_ costing.
  3. When a nonmonetary measure of productive activity such as labor hours or machine hours is used, the overhead rate is expressed in \_\_\_\_\_.
  4. Overhead is \_\_\_\_\_ to departments and \_\_\_\_\_ to production.
  5. Factory overhead charged to Work in Process may be credited either to \_\_\_\_\_ or \_\_\_\_\_.
  6. The difference between actual and applied factory overhead is called \_\_\_\_\_.
  7. A \_\_\_\_\_ discloses the overhead costs allowed for a particular level of activity during a period of time.
  8. A budget which is not adjusted for activity levels is called a \_\_\_\_\_.
  9. A graphical technique for determining the variability of costs is called a \_\_\_\_\_.

**6-16** The overhead cost per unit of product for a particular department during 3 successive months was \$18, \$19.75, and \$20.30. The plant manager was highly critical of the performance of the department supervisor in controlling overhead. Do you agree with the plant manager? Give reasons.

**6-17** The Arcadia Machining Company manufactures tools and dies according to customer specifications. It uses a predetermined overhead rate which is set at the beginning of the year on the basis of expected sales. In 1963, the overhead rate was \$4 per machine hour, based on 200,000 budgeted machine hours and \$800,000 of overhead at the expected sales level. In 1964, based on forecast sales, the plant was expected to operate at a level of only 100,000 machine hours, while overhead was expected to drop to \$700,000. Finished tools and dies are shipped to customers as completed. At the end of 1963 and 1964, jobs still in process contained 15,000 hours of machine time.

*Required:*

1. What effect does the overhead costing procedure of the company have on the income statements and balance sheets for 1963 and 1964? As a CPA, would you consider this method of overhead costing acceptable?
2. What effect might this system have on price quotations?

**6-18** The fixed overhead of the stamping department of Metal Products, Inc., is estimated at \$100,000 and the variable overhead at 50 cents per machine hour. The various possible levels for setting the predetermined overhead rate for the stamping department are as follows:

Maximum capacity.....	100,000 machine hr
Practical capacity.....	80,000 machine hr
Expected capacity.....	70,000 machine hr
Normal capacity.....	75,000 machine hr
Actual level.....	72,000 machine hr

*Required:*

1. Define the various types of capacities listed?
2. Calculate the predetermined overhead cost per machine hour for each of the different capacities listed.
3. Calculate the volume variance based on the use of each of the predetermined rates established in (2).

6-19

The Saybrook Chemical Company manufactured two products, Alpha and Beta, during the first year of its operations. For purposes of product costing, an overhead rate of \$1.70 per hour was used, based on budgeted factory overhead of \$340,000 and 200,000 budgeted hours, as shown below:

	<i>Budgeted overhead</i>	<i>Budgeted hours</i>
Dept. 1.....	\$240,000	100,000
Dept. 2.....	100,000	100,000
Total.....	\$340,000	200,000

The number of hours required to manufacture each of these products is shown below.

	<i>Alpha</i>	<i>Beta</i>
Dept. 1.....	4	1
Dept. 2.....	1	4
Total.....	5	5

At the end of the year there was no work in process and 10,000 finished units of Alpha on hand.

*Required:*

1. What is the effect on the company's income of using a plant-overhead rate instead of departmental overhead rates?
2. Assume that materials and labor cost per unit of Alpha are \$10 per unit and that the sales department establishes selling prices by adding 40 percent to factory costs to cover profit and selling and administrative expenses. What would the price of Alpha be if a plant-overhead rate is used and if departmental overhead rates are used?

6-20

*Possible explanations of underapplied factory overhead.* The Work in Process account of Department B of the Yoder Company contains a debit balance after factory overhead based upon a normal, predetermined rate, which includes an allowance for net profit, has been applied to production. The firm charges actual factory overhead incurred directly to the Work in Process account and does not maintain a Factory Overhead account. Indicate what may account for the debit balance in the Work in Process account. Describe how each of the factors which account for the balance may be important for management.



- 6-21** *Overhead costing.* The I. M. Fine Company has three producing departments, molding, spraying, and assembly, and one service department, general plant. Monthly overhead budget allowances for the three producing departments, which include prorated general-plant charges, are as follows:

Molding \$8,500 + 75 cents per machine hr  
 Spraying \$4,000 + 80 cents per direct-labor hr  
 Assembly \$3,000 + 40 cents per direct-labor hr

The monthly budget allowance for general plant is as follows:

General plant \$11,000 + 10 cents per direct-labor hr (producing departments)

Overhead rates for charging factory-overhead costs to production are set at the following monthly budgeted activity levels:

Molding 10,000 machine hr  
           5,000 direct-labor hr  
 Spraying 20,000 direct-labor hr  
 Assembly 30,000 direct-labor hr

General plant overhead is billed to producing departments each month at a predetermined billing rate. The billing rate has been set at an activity level equal to the total budgeted direct labor hours of producing departments.

Actual data for the month of February were as follows:

	<i>Level of operations</i>	<i>Direct department overhead</i>
Molding.....	9,500 machine hr 5,000 direct-labor hr	\$14,600
Spraying.....	22,000 direct-labor hr	15,000
Assembly.....	28,000 direct-labor hr	6,400
General plant.....	55,000 direct-labor hr	16,900

*Required:*

1. Calculate the overhead absorption rates for producing departments and the billing rate for general plant.
2. Record all journal entries for February.
3. Separate under- or overapplied overhead for each producing department and the difference between actual and billed overhead for general plant into volume and budget variances.

- 6-22** *Overhead cost flow. Reconstructing the accounts.* Based on the fragmentary data contained in the accounts of the Merrimac Company which follow, you are to record all the debits and credits necessary to complete these accounts. Materials and conversion costs in Department 2 are applied uniformly and continuously.



Work in Process I		Work in Process II		Finished Goods	
Beg. bal. -0-	25,000 (10,000 units)	Beg. bal. -0-		Beg. bal. -0-	
Mat. 18,000		D.L. 4,000			
D.L. 12,000		O.H. 7,000	End. bal. 2,000 units, $\frac{1}{2}$ complete		End. bal. 1,000 units
		Mat. 25,000			
Service Dept. X		Service Dept. Y			
4,000	4,000		3,000		
Factory Overhead I		Factory Overhead II			
Direct 5,600		Dept. X 1,400			
Dept. X 1,800					
Dept. Y 1,600					
Overhead Applied I		Overhead Applied II			
Under- or Overapplied Overhead I		Under- or Overapplied Overhead II			
	500				
Budget Variance I		Budget Variance II			
		400			
Volume Variance I		Volume Variance II			
100			300		

- 6-23 *Underabsorbed factory overhead.* The A Company, engaged in production of heavy equipment, has applied factory overhead to its product on the basis of an average rate of 115 percent of direct-labor cost. This rate, at the time it was established, was based on the following information concerning expected operations:

Direct-labor hr.....	136,000
Direct-labor cost.....	\$163,200.00
Average rate per hr.....	\$1.20
Fixed overhead.....	\$ 57,936
Variable overhead.....	129,744
Total overhead.....	\$187,680.00

At December 31, the end of the first accounting period, the records disclosed the following information:

Direct-labor hr.....	130,000
Direct-labor cost.....	\$183,040.00
Average rate per hr.....	\$1.408
Fixed overhead.....	\$ 75,400
Variable overhead.....	145,600
Total overhead (actual expense).....	\$221,000.00
Underabsorbed overhead.....	\$ 10,504.00

The management is concerned with the fact that it failed to absorb overhead of \$10,504 in the year's operations.

1. You are to discuss and criticize the system currently being used to absorb overhead.
2. You are to prepare an explanation for management showing why the \$10,504 underabsorption existed. You are to compute and show the effect of variation in indirect-labor rates and direct-labor hours on the absorption of both fixed and variable overhead. Support your conclusions with computations and explanatory comments setting forth the significance of each item in the analysis. (Computations should be corrected to the nearest dollar.)

(AICPA)

- 6-24 *Measurement of capacity; effect of capacity on costs.* Although various bases can be used to apply factory overhead to product costs, such as direct-labor hours or direct-labor cost, a problem of more fundamental importance is the way in which each of these bases is expressed. That is, should the base decided upon be expressed in terms of expected capacity, average capacity, or practical capacity? The use of rates based on each of these capacities may give different results.

1. Give a brief explanation of the three terms.
2. Describe the differences which can be expected to result when the different capacities are used. Include in your discussion an explanation of the effect of each basis on the differences between actual and applied overhead.

(AICPA)

- 6-25 *Accounting for waste and inefficiency; concepts for waste measurement.* Discuss the following quotation from the standpoint of:

1. The places in the accounting procedure at which wastes may be most readily recognized, measured, and analyzed
2. The accounting techniques available to aid in isolating these wastes

"Gradually the older belief that every expense incurred in the factory must be considered a cost of the products of the factory is giving way to the more logical one which recognizes that some of the expenditures . . . are costs of goods and some are costs of idleness, of wasted time and material, and of general inefficiency."

(AICPA)

**6-26** *Costs, volume, and price determination.* A company engaged in shipbuilding completed a large volume of new construction on private account for a fixed price in the middle of its fiscal year and, having no new business then available, entered into a government repair contract using substantially all its facilities. The contract was on a cost-plus-a-fixed-fee basis.

The plant overhead (burden) rate prior to taking the repair contract was about 75 cents per direct-labor hour. After the repair contract was started, it was about \$1.25, and for the year it averaged \$1. In its accounts the company always had adjusted the rate monthly, and it thus charged overhead to the new contract at \$1.25 per hour.

The volume of business in the yard, measured by total direct-labor hours, was substantially less after the completion of the new construction work than it had been while such work was in process. However, the first few months of the next fiscal year continued to show the higher overhead rate, even as volume increased to nearly the former levels. (The burden consisted mainly of supervisory and indirect labor, the plant itself belonging to the government.) The repair contract required that for cost reimbursement purposes overhead "shall be determined annually in accordance with the contractor's regular accounting practices provided they conform to generally accepted accounting principles." The government maintained that the annual rate of \$1 should be used, while the contractor claimed the use of the \$1.25 rate as charged on its books.

You are called as an expert witness to testify whether the method used conformed to generally accepted accounting principles. Discuss the situation fully, including:

1. Discussion of the annual or monthly rates
2. The appropriateness of the use of a direct-labor-hour rate
3. The questions about which you would like to obtain more information before testifying.

(AICPA)

**6-27** *Determination of appropriate factory overhead rate.* You have been asked to install a cost system for Martin Co. Your investigation of the manufacturing operations of the business discloses these facts:

1. The company makes a line of lighting fixtures and lamps. The materials cost of any particular item ranges from 15 to 60 percent of total factory cost, depending on the kind of metal and fabric used in making it.
2. The business is subject to wide cyclical fluctuations, since the sales volume follows new housing construction.
3. About 60 percent of the manufacturing is normally done in the first quarter of the year.

4. For the whole plant the wage rates range from \$1.25 to \$3.75 an hour. However, within each of the eight individual departments, the spread between the high and low wage rate is less than 5 percent.
5. Each of the products made uses all eight of the manufacturing departments, but not proportionately.
6. Within the individual manufacturing departments, factory overhead ranges from 30 to 80 percent of conversion cost.

Based on the above information, you are to prepare a statement or letter for the president of the company, explaining whether in its cost system Martin Co. should use the following:

1. A normal overhead rate or an actual overhead rate
2. An over-all overhead rate or a departmental overhead rate
3. A method of factory-overhead distribution based on direct-labor hours, direct-labor cost, or prime cost

Include the reasons supporting each of your three recommendations.

(AICPA)

6-28

*Factory-overhead and fixed-asset construction.* A manufacturer of heavy machinery is contemplating replacing a considerable portion of the company's productive machinery. Much of the new machinery will be manufactured by the company. Give your opinion on the following methods of allocating factory overhead incurred during the construction of the new machinery:

1. Charge no overhead to the new machinery.
2. Charge new machinery with only that portion of overhead which is attributable to the new construction.
3. Charge new machinery with overhead at the same rate that is used for finished goods.

What are the arguments in favor of each of these alternatives?

Which alternative would you recommend? State the reasons for your choice.

(AICPA)

6-29

*Overhead cost control.* The overhead absorption rate for the winding department of the Brite Lite Corporation is \$3 per hour and was established as follows (based on a budgeted level of activity of 30,000 hours):

Budgeted overhead costs:	Fixed	Variable per hr
Supervision.....	\$16,000	—0—
Materials handling.....	5,000	.15
Quality inspection.....	10,000	.10
Overtime premium.....	—0—	.08
Clerical.....	6,000	—0—
Payroll taxes and fringe benefits...	3,000	.12
Supplies.....	7,000	.40
Repairs and maintenance.....	3,000	.10
Rework.....	—0—	.05
Depreciation of machinery.....	2,500	—0—
Allocated general plant.....	7,500	—0—
Total.....	<u>\$60,000</u>	<u>\$1.00</u>
Fixed rate per hour.....		<u>2.00</u>
Total overhead rate.....		<u>\$3.00</u>

During the month of April, the winding department actually worked 28,000 hours and incurred the following actual overhead costs:

Supervision.....	\$16,000
Materials handling.....	11,200
Quality inspection.....	13,400
Overtime premium.....	1,600
Clerical.....	6,200
Payroll taxes and fringe benefits.....	6,100
Idle time.....	800
Supplies.....	16,900
Repairs and maintenance.....	7,400
Depreciation of machinery.....	2,600
Allocated general plant.....	6,900
Total.....	<u>\$89,100</u>

*Required:*

1. What was the amount of overhead charged to production by the winding department in April?
2. What was the overhead budget allowance for the winding department?
3. What were the budget and volume variances?
4. Prepare a control report to be issued to the manager of the winding department.
5. What comments would you make to the plant manager, if asked, regarding the performance of the manager of the winding department in controlling overhead?

6-30

*Relevant overhead costs for shutdown decision.* The Cool Motor Company manufactures motors on a contract basis. The operations are (1) machining, (2) assembling, and (3) testing. The company also maintains a pattern-making department, a purchasing department, a receiving department, a stockroom, and factory offices.

On June 1, the company has only one order in the shop. This calls for 3,000 motors, and because of a depression in the industry no further orders are expected until about September 1. The company normally operates at about 75 percent of capacity, and the order for 3,000 motors equals about 1 month's output at this rate.

The management is undecided whether they should complete this order during June and close the plant during July and August or spread the order over 3 months (1,000 per month) and operate at 25 percent of capacity. Operating at 75 percent of capacity, direct labor is estimated to be about \$40,000 in the machining department, \$30,000 in assembly, and \$10,000 in the testing department. If the plant operates at 25 percent of capacity, direct labor is estimated to be about \$20,000 in machining, \$10,000 in assembly, and \$10,000 in testing. If the plant is idle, no direct-labor costs will be incurred.

The details of the overhead expenses at 75, 25, and 0 percent of capacity levels are shown in the exhibit which follows.

*Required:*

1. What decision should the company's management make on the basis of the facts given?



2. Are there any other costs not at present appearing in the exhibit that might be relevant in this type of decision?

**COOL MOTOR COMPANY**  
Estimated Monthly Overhead Costs at Designated Levels of Operation

	75% capacity	25% capacity	Idle
Depreciation—buildings.....	\$ 1,600	\$ 1,600	\$ 1,600
Depreciation—machinery and equipment.....	3,200	3,200	3,200
Taxes—property.....	800	800	800
Fire insurance.....	400	400	400
Superintendence.....	800	800	800
Indirect labor:			
Machining.....	10,000	6,000	800
Assembly.....	6,000	4,000	—0—
Testing.....	6,000	4,000	600
Patternmaking.....	6,000	2,000	2,000
Stockroom.....	2,000	2,000	2,000
Wages and salaries:			
Purchasing and receiving.....	1,600	1,600	1,600
Factory office.....	2,400	2,400	2,400
Supplies:			
Machining.....	400	200	120
Assembly.....	200	166	—0—
Testing.....	622	220	100
Patternmaking.....	400	200	200
Purchasing and receiving.....	100	100	100
Factory office.....	78	74	72
Heat and light.....	1,000	800	400
Power.....	3,320	1,600	200
Compensation insurance.....	2,280	1,240	188
Repairs—machinery.....	800	600	—0—
	<u>\$50,000</u>	<u>\$34,000</u>	<u>\$17,580</u>

## 7. **Job-order Cost Accounting**

Cost accounting systems may be classified in the following ways:

- I. According to the nature of production activity
  - A. Job-order cost system
  - B. Process cost system
  - C. Combination job-order-process system
- II. According to the nature of costs
  - A. Actual, historical, incurred cost system
  - B. Predetermined cost system
    - 1. Estimated, or normal, cost system
    - 2. Standard cost system

Whether a job-order cost system, a process cost system, or a combined arrangement is appropriate depends upon the nature of the firm's production activities. As suggested earlier, the essential difference between a job-order system and a process system is one of emphasis in the initial classification and accumulation of production costs.

The job-order cost system emphasizes the accumulation and attachment of costs to jobs or batches of product. Each job represents different manufacturing specifications. The process cost system, which is concerned with uniform products, stresses the collection of production costs for a specified period of time, by departments, processes, or cost centers through which products flow.

Under a job-order system, costs are identified directly with each job. Under a process system, after costs have been charged to producing departments, they are assigned to products manufactured. No effort is made in a process system to ascertain the specific cost of each discrete unit of production. Rather, the product costs which emerge are average costs which have been pyramided from department to department.

A shirt manufacturer is not interested in the cost of the one-hundredth or one-thousandth shirt produced, but rather in the average cost of a particular style, during a given period of time and for the various operations performed. On the other hand, the specific cost of each job is essential information to the management of an automobile repair shop. The job cost provides a basis for comparison with the sales price and serves as a reference for future price quotations on similar jobs.

A particular firm's cost accounting system may include the characteristics of both the job-order and the process systems. For example, a job-order system might be used in the machine shop of a company manufacturing standard products. Costs would be accumulated by jobs for work done in the machine shop for other departments.

Job-order features also may be utilized by firms which first assemble parts to make a product which is then processed through one or more finishing processes or departments. Production in the assembly operation may be divided into batches or jobs to which additional costs are attached as the jobs pass through the finishing process. In the assembly operation, costs are assigned to jobs; in the finishing process costs are assigned first to the processes or cost centers and then to the jobs as they pass through.

Either an actual or predetermined cost system, or a mixture of the two, such as actual materials and direct-labor costs and predetermined factory-overhead costs, may be combined with either a process system or a job-order system. Estimated costs, in particular, are commonly used in job-order costing, especially when the jobs cover lengthy time periods and consist of many items. The reason for this will be explained later in this chapter.

### **Type of production activity for the job-order arrangement**

A job-order cost accounting system is most appropriate when production consists of special jobs or projects, rather than when the products are standardized and the production pattern repetitive or continuous. Examples of this type of activity include design engineering, building construction, motion pictures, repair shops, and custom printing. The job-order arrangement also is used where the time required to manufacture a unit of product is rather long and where selling price is closely dependent upon production cost, as, for example, the production of wines, cheeses, and raw silk. The job-order cost system also is found in companies producing a variety of products such as nuts and bolts, where the production is scheduled by jobs.

When virtually every job produced is somewhat different, it is reasonable to assume that the production costs of each job also are different and that these costs can and should be accumulated separately. Costs which can be traced to a particular job, e.g., materials and labor, are charged directly to that job as soon as they are identified. Costs which are not directly related to any particular job are allocated to all jobs on some pro rata basis.

Most factory overhead costs are in the latter category, although some such as setup time, overtime premium, and design engineering often are charged directly to applicable jobs. Predetermined overhead rates are particularly useful in job-order costing. Since actual overhead costs cannot be determined until the end of the month or year, job costs cannot be known immediately upon completion without recourse to overhead rates.

These rates also provide management with a basis for cost estimating and price quotations.

### Job-order records

Because production is discontinuous under a job-order system, careful planning is required to attain the most economic utilization of manpower and machinery. Production planning commences with the receipt of a customer's order. This generally is the basis for the preparation and issuance to the factory of a *production order*. The production order contains information and instructions to the factory regarding product specifications, manufacturing time period, route schedule, machines to be used, etc. It may also contain a list of materials, parts, and tools required, although often this is issued on a separate *bill of materials*.

The unique accounting document under job-order costing is the job cost sheet. It contains the cost accumulation for each job, subdivided into major cost categories. A job-order cost sheet is illustrated in Fig. 7-1. Under a job-order system, as materials are requisitioned and labor incurred, the relevant job is noted on the materials requisition and time

JOB COST SHEET									
Job No. <u>101</u> Customer <u>Acme</u> Item <u>Pump repair</u> Qty. <u>1</u> Date Begun <u>6/4</u> Date Completed _____						Summary			
							Estimated Cost	Actual Cost	Difference
						Materials	25.00	22.60	2.40
						Labor	16.00	17.00	(1.00)
						Overhead	20.00	21.25	(1.25)
						Total	61.00	60.85	.15
Materials			Labor			Overhead			
Date	Req. No.	Amount	Date	Time Ticket	Amount	Date	Dept.	Rate	Amount
6/4	1006	22.60	6/4	10687	8.00	6/4	Assy.	125%	10.00
			6/5	10705	9.00	6/5	Assy.	125%	11.25
Total		22.60	Total		17.00	21.25			

Fig. 7-1 Job cost sheet.

<b>MATERIALS REQUISITION</b>			
Date Required <u>6/4</u>		Department <u>Assembly</u>	
		Job No. <u>101</u>	
Quantity	Item	Unit Cost	Amount
5	Brackets #10-651	1.40	7.00
12	Fittings #A683	.50	6.00
2	Tubing #2081	4.80	9.60
		Total	22.60
Approved by <u>T. Cochrane</u>		Date <u>6/3</u>	

Fig. 7-2 Materials requisition.

<b>TIME TICKET</b>					
					No. <u>10687</u>
Employee <u>R. Stark</u>			Department <u>Assembly</u>		
Clock No. <u>86</u>			Date <u>6/4</u>		
Time Begun	Time Ended	Elapsed	Rate	Amount	Job Order No.
8:00	11:30	3.5	2.00	7.00	105
11:30	12:00	.5		1.00	104
1:00	5:00	4.0		8.00	101
Totals		8.0		16.00	

Fig. 7-3 Time ticket.

ticket forms, as shown in Figs. 7-2 and 7-3. The job cost sheet also may indicate the estimated cost or the selling price to provide a measure of factory efficiency or profit or loss realized.

The job cost sheets constitute a subsidiary ledger to the Work in Process account. At any time, the balance in this account is equal to the



aggregate balances of the job cost sheets. When a job is completed, the cost is totaled on the job cost sheet and used as the basis for transferring the cost of the order to Finished Goods or Cost of Sales.

### Cost estimates for bidding on jobs

Cost estimates for bidding on jobs or projects which are contracted for on a competitive bid basis may be developed by analysis of a firm's past cost experience with identical or similar jobs or projects. Past experience should, of course, be modified by cost changes which have taken place and also by future cost expectations.

When the firm has had no previous experience with a particular type of project, the synthesis of a cost estimate for a contract may require a considerable amount of study. In such cases, the production requirements of a project are determined by establishing the amounts and types of materials needed, the amounts and types of labor required, and the types of processes or operations called for. Labor and materials cost can be estimated by reference to current rates and prices. The estimated time required in each of the operations multiplied by the average cost rates for each of the processes provides processing cost estimates for the project.

Certain types of costs create a problem in cost estimating. A decision must be made in some cases as to whether a particular cost should be charged to one specific job or project, or whether it should be spread among several. Preliminary design and engineering costs are an example. In some cases, these costs may not even bring in a job, in which case they should be absorbed by other jobs and included in bid estimates. Overtime premium and shift bonuses are additional examples of costs which, although traceable to a particular job, might be spread over several jobs.

Knowledge about the costing practices of competitors who also are bidding on jobs is helpful to the estimating decision, but this information is not always available. The competitive situation often governs the decision with respect to inclusion or exclusion of such costs in cost estimates.

### Cost estimates incorporated into the accounts

Cost estimates may be included in the accounts of a company. Generally this is done in order to provide increased cost control or to facilitate accounting for the flow of costs applicable to finished jobs. If these predetermined costs are based upon a good attainable level of performance, they are referred to as *standard costs*. If they represent expected actual costs, they are called *estimated costs*.

Cost estimates are particularly useful when job contracts call for completion of a certain number of units of product and deliveries over a rather extended period of time. An example is a contract for 500 sonar units for the Federal government, with 25 to be delivered each month.

*Exhibit 7-1*

Work in Process		
January	8,000	March (4 units)
February	36,000	
March	45,000	

In such a case, finished units are credited to Work in Process as they are completed. Although the actual cost per unit is not known until the entire contract is finished, estimated costs per unit can be used in the meantime to relieve the Work in Process account of production costs applicable to the completed and delivered production.

The use of cost estimates may be illustrated by assuming that a company has received an order for 80 specially designed refrigerated trucks. Each truck is estimated to cost \$4,000. Production was begun in January. In Exhibit 7-1, it is assumed that the charges to Work in Process apply exclusively to this job. As indicated, at the end of March total job costs amount to \$89,000. During March, four trucks were completed and delivered to the customer.

In order to complete the cost cycle, it now is necessary to relieve the Work in Process account and charge the Cost of Sales account for the cost of the completed and delivered trucks. However, the details in the job cost sheet represent a mixture of costs partly applicable to the finished units and partly related to the unfinished trucks being worked on. Under such circumstances, the actual cost per truck cannot be determined until the entire contract is completed.

When the cost estimate is incorporated in the accounts, Work in Process can be credited and Cost of Sales charged, i.e., at the end of March, in the amount of \$16,000 for the four completed trucks. When all 80 trucks have been manufactured, the remaining balance in the Work in Process account represents the amount that the actual costs have exceeded or are below the cost estimate. This balance is then closed out to the Cost of Sales account.

**Job cost control**

The problems of cost control in a job shop often are more complex than in a process type of manufacturing, where activities and responsibilities can be segregated by cost centers or departments and where operations tend to be recurrent. In a job shop, departmental subdivisions may not exist or may be poorly defined. Moreover, each job is a separate entity and may not be repeated.

Control over job-order costs tends to center on the relationship between cost estimates used as the basis for establishing job prices and actual costs. While a comparison between actual and estimated materials and labor costs by jobs does provide a basis for cost control, overhead

## Exhibit 7-2

**BATES AUTO REPAIRS INC.**  
**Cost Control Report—Body Shop**  
 Month of \_\_\_\_\_

Sales—body shop.....								\$5,658
Estimated body shop job costs.....								4,715
Estimated body shop direct profit.....								\$ 943
Job	Actual costs			Estimated costs			Variance	
	Materials	Labor	Total	Materials	Labor	Total		
101	\$ 320	\$ 500	\$ 820	\$ 350	\$ 510	\$ 860	\$ 40	
102	160	180	340	175	190	365	25	
103	85	120	205	90	110	200	(5)	
105	275	275	550	265	350	615	65	
108	140	160	300	140	180	320	20	
111	110	170	280	115	140	255	(25)	
112	205	240	445	200	210	410	(35)	
Total...	\$1,295	\$1,645	\$2,940	\$1,335	\$1,690	\$3,025	\$ 85	
Department-overhead budget variance.....							(130)	
Department-overhead volume variance.....							(150)	\$ 195
Actual body shop direct profit.....								\$ 748

cannot be controlled in terms of specific jobs. Overhead control must be exercised by department heads or higher levels of management.

When a job shop is divided into departments or cost centers, a cost control report such as that shown in Exhibit 7-2 can be prepared. When this type of organizational breakdown exists, the actual impact on estimated profit of departmental activities can be directly traced as shown in Exhibit 7-2. (The details of the department-overhead budget variance will be reported separately.)

### Job costs and periodicity

A major manufacturing project, such as a large building construction job may extend over several months or even over several years. When a project extends over the end of a firm's fiscal period, it is necessary to determine periodic income in some manner, even though the project has not been completed.

One method for doing this is to estimate the percentage of completion of the project, in terms of the costs which have been incurred to date relative to the total estimated costs for the entire project. Revenue may then be accrued in the amount of the completion percentage times the

total contract price. Frequently "progress payments" are made to the construction contractor based upon the achievement of certain stages of completion. These are recognized as revenue against which are matched the construction costs incurred to date.

Assume, for example, that the Ballantine Company is building a construction project for a contract price of \$270,000 with progress payments of \$90,000 to be received at each one-third stage of completion. At the end of the first year of work on the project, the project is one-half finished, and costs of \$120,000 have been incurred of an estimated total of \$240,000 for the project.

At the time of the first progress payment, the following entry might have been made:

Cash.....	90,000	
Revenue.....		90,000
Cost of Production Completed.....	80,000	
Work in Process.....		80,000

At the end of the first year of work, when the project is one-half finished, additional revenue might be accrued, and additional costs might be transferred from Work in Process to the Cost of Production Completed account as follows:

Cost of Production Completed.....	40,000	
Work in Process.....		40,000
Estimated Revenue Receivable.....	45,000	
Revenue.....		45,000

Income based upon progress payments amounts to \$10,000. If additional revenues and costs are accrued to reflect the percentage of completion, income amounts, instead, to \$15,000. In reporting income in such a situation, it is good reporting to indicate the basis which is assumed.

### Job-order cost illustration

The Sun Company, Inc., constructs outdoor swimming pools according to the special demands of its customers. Pools may be circular, square, kidney-shaped, rectangular, or any other particular design desired. The usual materials which the Sun Company uses for pool construction are:

- |  |  |
|--|--|
| 1. Cement and sand (for concrete)            | 5. Filter apparatus                              |
| 2. Diving boards                             | 6. Drain and pipe connecting to filter apparatus |
| 3. Pool ladders                              | 7. Pool heater                                   |
| 4. Steel rods (for reinforcing the concrete) |  |

The Sun Company subcontracts the Hole Company on a per hour basis to dig the hole for the pool using mechanical equipment. The Sun Company uses its own employees to put the finishing touches on digging the hole, using shovels.



After the hole is dug, forms are installed around the sides of the hole which serve as a mold for the concrete. Before the concrete is poured, the drain and pipes leading to the filter and to the heater are installed. Equipment (other than digging equipment) which is required is owned by the company and consists of a cement mixer, forms for the concrete sides, a truck for hauling the equipment from the company's office and storage facility, a car for the salesman's use, and various tools including shovels.

When the forms are in place around the sides of the pool, cement, sand, and water are mixed into concrete, which is then poured into the forms. Concrete also is poured to form the floor of the pool.

When the concrete in the sides and floor of the pool is firm, the forms are removed, and finishing work is done to make the concrete smooth. The final step is the installation of the filter and heater and the mixing and pouring of concrete for the poolside area.

The Sun Company maintains an office and also a storage facility in the same building, which it rents. The office takes up about one-fourth of the building. In the storage facility the Sun Company keeps an inventory of cement, steel reinforcing rods, diving boards, pool ladders, drains, filter apparatus, pool heaters, and pipe. In addition, tools, the cement mixer, the forms, the truck, and the car are stored at this location.

The company employs three men and one foreman for pool work plus a salesman, and a secretary who also does the accounting work. The

### Exhibit 7-3

#### THE SUN COMPANY, INC.

##### Balance Sheet January 1

<i>Assets</i>		<i>Liabilities</i>	
Current:		Current:	
Cash .....	\$ 1,500	Accounts payable and	
Accounts receivable .....	9,000	other accruals .....	\$ 2,000
Materials inventory .....	8,000	Note payable .....	4,000
Work in process .....	-0-		
Total current assets .....	\$18,500	Total liabilities .....	\$ 6,000
Fixed:		<i>Net Worth</i>	
Truck .....	\$2,500	Capital stock .....	\$15,000
Less: Accumulated depreciation ..	1,000	Retained earnings .....	1,700
Cement Mixer .....	1,200	Total net worth .....	\$16,700
Less: Accumulated depreciation ..	300		
Office Equipment .....	800		
Less: Accumulated depreciation ..	200		
Car .....	2,000		
Less: Accumulated depreciation ..	800		
Total fixed assets .....	\$ 4,200	Total liabilities and net	
Total assets .....	\$22,700	worth .....	\$22,700



salesman is also the manager. The system of accounts was devised by a CPA firm which also does the firm's year-end accounting work such as tax returns and financial statements.

The firm does no construction during November, December, and January. The production men are laid off by the Sun Company during these months, and they are employed in another seasonal industry during 2 of the 3 winter months. The salesman continues to work during the off-season months, securing contracts for the following season. The secretary works the year round except for 2 weeks' vacation in December.

The illustration that follows portrays the activity for 2 months beginning January 1. At the beginning of the year, the Sun Company balance sheet was as shown in Exhibit 7-3.

During January, the following activity took place:

Cash receipts from customers.....	\$6,000
Cash payments:	
Secretary's salary.....	\$300
Salesman's salary.....	500
Rent on building.....	200
Utilities.....	20
Note payable.....	100
Car expense (gas, oil, etc.).....	60
Truck expense (gas, oil, etc.).....	10
	<u>1,190</u>
Excess of receipts over payments.....	<u>\$4,810</u>

The accounts were not closed at the end of January because there was no sales activity, but the following adjusting entries were made:

Depreciation of Car.....	33
Depreciation of Truck.....	42
Depreciation of Cement Mixer.....	13
Depreciation of Office Equipment.....	8
Accumulated Depreciation—Car.....	33
Accumulated Depreciation—Truck.....	42
Accumulated Depreciation—Cement Mixer.....	13
Accumulated Depreciation—Office Equipment.....	8

In February, construction work began for the season. Six pools were scheduled to be started in that month. Each pool is considered to be a separate job, and a job-order cost accounting system is used. Each season jobs are numbered, starting with 101. A job cost sheet for each job is maintained by the secretary, who enters the costs on these sheets periodically. Costs are charged to each job as soon as they are known. Materials taken out of the storage facility are written on a materials requisition slip in the storeroom. The secretary picks these up at the end of each day and enters the charges on the job cost sheets.

The construction employees are paid on an hourly basis and typically work a 40-hour week except in rush periods. The foreman keeps time

tickets, which are records each day of the time worked by each man on each job, and gives these to the secretary at the end of each day. Labor costs are charged to job cost sheets early on the following working day on the basis of the time tickets.

Since production does not take place in an enclosure called a factory, the term "construction overhead" is more appropriate than "factory overhead" and will be used in this case. The Sun Company uses a predetermined, or normal, overhead rate for purposes of charging construction overhead to jobs. The estimated construction overhead to be incurred during the year is calculated in January, and for this year it consisted of the following items and amounts:

Depreciation of cement mixer.....	\$ 150
Depreciation of truck.....	500
Rent of building (three-fourths portion).....	1,800
Tools (including shovels).....	150
Truck expense (gas, oil, etc.).....	480
Total.....	<u>\$3,080</u>

The truck and car were being depreciated over 5 years (straight-line), the cement mixer and office equipment over 8 years (straight-line), and tools were expensed when they are purchased. The building is leased for 10 years, and rent is paid monthly. The cement forms were expensed when purchased and therefore were not depreciated.

Direct-labor hours are used as the basis for applying construction overhead to the jobs. The company feels that materials cost would be just as good a basis for applying overhead, since the materials cost varies rather directly with the size of the pool, as does direct-labor cost. Estimated direct-labor hours are used, however, because they are somewhat easier to predict on the basis of four construction employees (the foreman is considered to be a direct laborer) each working 40 hours per week. Estimated direct-labor hours for the 9 operating months thus amount to 5,600 hours, 36 weeks (—1 week for sick leave, absences)  $\times$  4 men  $\times$  40 hours. Overhead is applied to the job cost sheets once each week. The predetermined, or normal, overhead rate amounts to 55 cents per direct-labor hour ( $\$3,080 \div 5,600$  hours).

The costs incurred for the various jobs during February are shown in Exhibit 7-4.

Jobs 101 to 104 were completed, and the customers were billed for \$3,000, \$2,700, \$3,200, and \$2,900, respectively. Construction payroll (including all taxes and fringe benefits) for the month amounted to:

Grade A direct labor (foreman).....	\$ 465.00
Grade B direct labor.....	1,077.50

During the month, 5 hours of the foreman's time and 15 hours of the construction workers' time was not chargeable to any job. The firm treats

## Exhibit 7-4

**THE SUN COMPANY**  
Job-order Costs during February

Job	Subcontract costs	Materials	Direct labor			Construction overhead (@ 55 cents per hr)
			Hours	Rate*	Amount	
101	\$ 400	\$1,631.50	30	\$3.00	\$ 90	\$ 71.50
			100	2.50	250	
102	500	1,624.50	20	3.00	60	66.00
			100	2.50	250	
103	450	1,508.00	30	3.00	90	77.00
			110	2.50	275	
104	350	1,753.50	40	3.00	120	71.50
			90	2.50	225	
105	300	—0—	10	3.00	30	11.00
			10	2.50	25	
106	400	—0—	20	3.00	60	44.00
			60	2.50	15	
Total . . .	\$2,400	\$6,517.50	620		\$1,490	\$341.00

\* Grade A direct labor at \$3 is the rate for the foreman, and Grade B direct labor at \$2.50 is the rate for the three other men.

this as an idle time loss and includes it in the supplementary overhead rate, described below.

For managerial purposes, the Sun Company also uses a supplementary overhead rate for purposes of charging jobs with office and selling costs as well as idle time losses. Although this is not acceptable for external reporting purposes, where statements are audited by certified public accountants, it is useful to the Sun Company in estimating costs for purposes of making bids and contracts. The sales and general office functions are regarded as service departments which aid the construction function. Direct-labor hours are also used as the basis for application. Estimated supplementary overhead for the year consisted of:

Idle time loss . . . . .	\$ 200
Depreciation of car . . . . .	400
Depreciation of office equipment . . . . .	100
Car expense (gas, oil, etc.) . . . . .	300
Utilities (entire amount) . . . . .	280
Rent (one-fourth) . . . . .	600
Secretary's salary . . . . .	3,600
Salesman's salary . . . . .	6,000
Total . . . . .	\$11,480

The supplementary predetermined overhead rate thus amounts to \$2.05 ( $\$11,480 \div 5,600$  hours).

Actual February activity was as follows:

Cash receipts from customers.....		\$2,000.00
Cash payments:		
Construction payroll.....	\$1,542.50	
Secretary's salary.....	300.00	
Salesman's salary.....	500.00	
Rent of building.....	200.00	
Utilities.....	25.00	
Notes payable.....	100.00	
Car expense (gas, oil, etc.).....	45.00	
Truck expense (gas, oil, etc.).....	55.00	
Tools.....	60.00	\$2,827.50
Excess of payments over receipts.....		(\$ 827.50)

Monthly adjustments made in the accounts were:

Depreciation of Car.....	33
Depreciation of Truck.....	42
Depreciation of Cement Mixer.....	13
Depreciation of Office Equipment.....	8
Accumulated Depreciation—Car.....	33
Accumulated Depreciation—Truck.....	42
Accumulated Depreciation—Cement Mixer.....	13
Accumulated Depreciation—Office Equipment.....	8

Exhibit 7-5 shows the accounts of the Sun Company after all of the recording of the month's activity had been completed. Following this, the entries expressed in general journal form are shown in Exhibit 7-6. The entries are keyed into the accounts to enhance an understanding of how a job-order cost system ties in with the complete set of accounts maintained by the Sun Company.

Exhibit 7-5

THE SUN COMPANY, INC.  
Cost Accounts and General Financial Accounts  
January to February

Cash		Accumulated Depreciation: Truck	
(a) 1,500	(b) 1,190.00	(a) 1,000	
(b) 6,000	(e) 2,400.00	(c) 42	
(i) 2,000	(i) 2,827.50	(j) 42	

*Exhibit 7-5 (Continued)*

Accounts Receivable			
(a)	9,000	(b)	6,000
(k)	11,800	(i)	2,000

Fixed Assets: Cement Mixer	
(a)	1,200

Materials Inventory			
(a)	8,000	(d)	6,517.50

Accumulated Depreciation: Cement Mixer	
(a)	300
(c)	13
(j)	13

Work in Process			
(a)	-0-	(k)	10,929.50
(d)	6,517.50		
(e)	2,400.00		
(f)	1,490.00		
(g)	341.00		
(h)	1,271.00		

Fixed Assets: Car	
(a)	2,000

Fixed Assets: Truck	
(a)	2,500

Accumulated Depreciation: Car	
(a)	800
(c)	33
(j)	33

Fixed Assets: Office Equipment	
(a)	800.00

Retained Earnings	
(a)	1,700



*Exhibit 7-5 (Continued)*

Accumulated Depreciation:  
Office Equipment

	(a)	200
	(c)	8
	(j)	8

Pool Sales

	(k)	11,800
--	-----	--------

Accounts Payable and Other Accruals

(i)	1,542.50	(a)	2,000.00
		(f)	1,542.50

Cost of Goods Sold

(k)	10,929.50
-----	-----------

Note Payable

(b)	100	(a)	4,000
(i)	100		

Construction Overhead Control

(b)	160	(g)	341
(c)	55		
(i)	265		
(j)	55		

Capital Stock

	(a)	15,000
--	-----	--------

Supplementary Overhead Control

(b)	930.00	(h)	1.271
(c)	41.00		
(f)	52.50		
(i)	920.00		
(j)	11.00		

Subsidiary ledger-Construction  
Overhead Control:

Rent on Building

(b)	150
(i)	150

--	--

*Exhibit 7-5 (Continued)*

Truck Expense	
(b)	10
(i)	55



Depreciation of Truck	
(c)	42
(j)	42



Depreciation of Cement Mixer	
(c)	13
(j)	13

*Subsidiary ledger—Supplementary  
Overhead Control:*  
Secretary's Salary

Secretary's Salary	
(b)	300
(i)	300

Tools	
(i)	60

Salesman's Salary	
(b)	500
(i)	500

Rent on Building	
(b)	50
(i)	50

Depreciation of Car	
(c)	33
(j)	33

## Exhibit 7-5 (Continued)

Utilities		Depreciation of Office Equipment	
(b)	20	(c)	8
(i)	25	(j)	8

Car Expense		Idle Time Loss	
(b)	60	(f)	52.50
(i)	45		

Job cost sheets (subsidiary ledger to Work in Process):

Selling price	Sub-contract cost	Materials	Direct labor	Construction overhead	Supplementary overhead	Total cost
Job 101, \$3,000	\$400	\$1,631.50	A—30 hr @ \$3—\$90 B—100 hr @ \$2.50—\$250	\$71.50	\$266.50	\$2,709.50 (completed)
Job 102, \$2,700	500	1,624.50	A—20 hr @ \$3—\$60 B—100 hr @ \$2.50—\$250	66.00	246.00	2,746.50 (completed)
Job 103, \$3,200	450	1,508.00	A—30 hr @ \$3—\$90 B—110 hr @ \$2.50—\$275	77.00	287.00	2,687.00 (completed)
Job 104, \$2,900	350	1,753.50	A—40 hr @ \$3—\$120 B—90 hr @ \$2.50—\$225	71.50	266.50	2,786.50 (completed)
Job 105, \$2,600	300	-0-	A—10 hr @ \$3—\$30 B—10 hr @ \$2.50—\$25	11.00	41.00	407.00 (incomplete)
Job 106, \$2,800	400	-0-	A—20 hr @ \$3—\$60 B—60 hr @ \$2.50—\$15	44.00	164.00	683.00 (incomplete)

## Exhibit 7-6

**THE SUN COMPANY, INC.**  
Explanation of Activity in Accounts

- (a) The balances of the accounts according to the January 1 balance sheet.  
(b) January cash receipts and payments.

Cash.....	6,000	6,000
Accounts Receivable.....		
Construction Overhead Control.....	160	
Supplementary Overhead Control.....	930	
Notes Payable.....	100	
Cash.....		1,190

The breakdown of construction and supplementary overhead is charged to the subsidiary overhead accounts as follows:

Construction:	150
Rent on Building (three-fourths portion).....	10
Truck Expense.....	160
Total.....	
Supplementary:	300
Secretary's Salary.....	500
Salesman's Salary.....	50
Rent on Building (one-fourth portion).....	20
Utilities.....	60
Car Expense.....	930
Total.....	

(c) Adjustments made at the end of January. These adjustments have been presented in general journal form earlier in the chapter. Depreciation of the truck and cement mixer are charged to the Construction Overhead Control account and to the subsidiary accounts indicated in the entry shown earlier. Similarly, depreciation of car and office equipment are charged to Supplementary Overhead Control and the appropriate subsidiary accounts.

- (d) Summary of materials used on jobs during February amounted to:

Work in process.....	6,517.50
Job 101.....	1,631.50
Job 102.....	1,624.50
Job 103.....	1,508.00
Job 104.....	1,753.50
Materials Inventory.....	6,517.50

The secretary charged the job cost sheets, which constitute the subsidiary ledger for Work in Process, daily as she received the materials requisition slips from the construction employees. The charge to Work in Process and the credit to Materials Inventory were made in total at the end of the month, after all the materials requisition slips for the month were added. This procedure provides a clerical check, since at the end of the month, when all accounting work is finished,

*Exhibit 7-6 (Continued)*

the balance of Work in Process Control account must agree with the totals of the individual job cost sheets.

(e) Subcontract costs were paid this month and charged to jobs.

Work in Process.....	2,400
Job 101.....	400
Job 102.....	500
Job 103.....	450
Job 104.....	350
Job 105.....	300
Job 106.....	400
Cash.....	2,400

(f) Construction payroll for February was recorded and charged to jobs on the basis of time tickets made out by the foreman each day. Charges to jobs have been made daily. The calculation of the payroll and the entry to Work in Process Control account and the liability are made at the end of the month.

*Charges to subsidiary ledger:*

Job 101.....	340
Job 102.....	310
Job 103.....	365
Job 104.....	345
Job 105.....	55
Job 106.....	75
	<u>1,490</u>

*Summary entry to record payroll at end of month:*

Work in Process.....	1,490	
Supplementary Overhead Control (Idle Time Loss).....	52.50	
Accounts Payable and Other Accruals.....		1,542.50

(g) Construction overhead at 55 cents per direct-labor hour as shown on the time tickets was applied to the individual job cost sheets once each week and in total to Work in Process Control at the end of the month.

*Subsidiary:*

Job 101.....	71.50
Job 102.....	66.00
Job 103.....	77.00
Job 104.....	71.50
Job 105.....	11.00
Job 106.....	44.00
	<u>341.00</u>

*Control:*

Work in Process.....	341.00	
Construction Overhead Control.....		341.00



*Exhibit 7-6 (Continued)*

(h) Supplementary overhead at the rate of \$2.05 per direct-labor hour as shown on the time tickets is charged to the individual job cost sheets once each week and to Work in Process Control at the end of the month.

*Subsidiary:*

Job 101.....	266.50
Job 102.....	246.00
Job 103.....	287.00
Job 104.....	266.50
Job 105.....	41.00
Job 106.....	164.00
	<u>1,271.00</u>

*Control:*

Work in Process.....	1,271	
Supplementary Overhead Control.....		1,271

(i) February cash receipts and payments:

Cash.....	2,000.00	
Accounts Receivable.....		2,000.00
Accounts Payable and Other Accruals.....	1,542.50	
Construction Overhead Control.....	265.00	
Supplementary Overhead Control.....	920.00	
Notes Payable.....	100.00	
Cash.....		2,827.50

The details of construction and supplementary overhead are charged to the subsidiary overhead accounts as follows:

Construction:	
Rent on Building.....	150
Truck Expense.....	55
Tools.....	60
	<u>265</u>
Supplementary:	
Secretary's Salary.....	300
Salesman's Salary.....	500
Rent on Building.....	50
Utilities.....	25
Car Expense (gas, oil, etc.).....	45
	<u>920</u>

(j) Adjustments made at the end of February are the same as those in (c) above.

(k) Jobs 101 to 104 were completed during the month. Customers were billed, and the following entry was made:

Accounts Receivable.....	11,800	
Pool Sales.....		11,800

*Exhibit 7-6 (Continued)*

Job cost sheets for these completed jobs were removed from the subsidiary Work in Process ledger and totaled, and the following entry made to the control account:

Cost of Goods Sold.....	10,929.50	
Work in Process.....		10,929.50

The Sun Company does not use a Finished Goods account, because it does not store the pools. The completed pools remain in Work in Process until customers are billed. Billing ordinarily occurs immediately upon completion of the construction.

*Problems and cases*

- 7-1 *Costing of completed units of a job.* The Jefferson Electric Company has accepted a large government order for radar equipment. The order calls for shipments to be made each month over an 8-month period. A job sheet has been set up to collect the relevant factory costs. At the end of the first month, the controller asks you to advise him as to what amount he should credit to Work in Process and charge to Cost of Sales for two units completed and shipped during the first month. What problem is presented? How would you resolve it?
- 7-2 *Cost control in a job shop.* The Industrial Boiler Company manufactures and installs boilers according to customer specifications. Prices are quoted on the basis of cost estimates, plus 40 percent to cover selling and administrative expenses and profit. Actual costs are accumulated by job orders. If you were the controller of this company, how would you attempt to control costs in the factory?
- 7-3 *Cost of defective work.* The Landy Plastic Corporation has a large compression-molding machine on which it manufactures custom jobs. In analyzing the profit realized on jobs completed, it was disclosed that one job showed a large loss, whereas the others were profitable. Investigation revealed that the machine had been defective when this job was processed and had caused an unusually large amount of scrap. After completion of the job the machine had been repaired. Do you agree with the accounting results obtained? If not, what would you suggest?
- 7-4 *Profit generated internally.* The machine shop of the United Motors Corporation charges producing departments for services on the basis of an hourly billing rate equal to that used by a large independent local machine shop. Actual costs are accumulated in jobs and the difference between the actual costs and the amounts billed to producing departments is regarded as the profit of the machine shop, as if it were independent. The manager of the machine shop is paid a bonus based on a share of the profit earned. Do you agree with this procedure?

- 7-5 *Production scheduling and job costs.* The White Collar Shirt Company schedules its production in specific lots. Approximately 20 different styles are manufactured. Since production is based on lots, the controller feels that it is advantageous also to accumulate costs by these lots. What advantages and disadvantages do you see to this system?
- 7-6 *Accounting for excess materials.* Upon completion of a job it was found that there was an excess of materials. What accounting treatment should be accorded these materials?
- 7-7 *Overhead allocation bases.* "What difference does it really make whether we use one base or another for allocating costs to jobs? Whatever method we use, we end up allocating total overhead to jobs and follow the method consistently." Comment.
- 7-8 *Order size and pricing.* Should the size of an order affect the price quoted? Why?
- 7-9 *Product costs.* The Newman Company has developed a new product which it hopes to market in the following way:
1. Produce a limited quantity, and charge a high market price initially to obtain exceptional profits before competitors enter the field with imitations, copies, or substitutes.
  2. Lower the market price drastically, and produce large quantities after competitors enter the market.
- Describe how job-order cost information developed during the accomplishment of (1) might be useful in the accomplishment of (2).
- 7-10 *Flow of costs in job-order system.* Indicate by the use of journal entries or T accounts, for the data below, the flow of costs through the cost accounts of the Shallen Company, which uses a job-order cost system. Describe the activity in the subsidiary records.

1. Materials used on jobs during the month of August amounted to:

Job 201.....	\$ 3,263
Job 202.....	3,249
Job 203.....	3,016
Job 204.....	3,507
Total.....	\$13,035

2. Direct-labor payroll, according to the time tickets and labor cost summary, was:

Job number	Direct-labor dollars	Direct-labor hours
201	\$ 680	340
202	620	310
203	730	365
204	690	345
	\$2,720	1,360

3. Factory overhead is applied to jobs at the rate of \$4 per direct-labor hour worked.
4. Jobs 201, 202, and 203 were completed during the month. Jobs 201 and 202 were delivered to the customer at a sales price of \$5,000 and \$5,700, respectively.

**7-11** *Job-order costs and inventory valuation.* The H Manufacturing Company is engaged in manufacturing items to fill specific orders received from its customers. While at any given time it may have substantial inventories of work in process and finished goods, all such amounts are assignable to firm sales orders which it has received.

The company's operations, including the administrative and sales functions, are completely departmentalized. Its cost system is on a job-order basis. Direct materials and direct labor are identified with jobs by the use of materials issue tickets and daily time cards. Overhead costs are accumulated for each factory service and administrative and selling department. These overhead costs, including administrative and selling expenses, are then allocated to production departments, and an overhead rate is computed for each production department. This rate is used to apply overhead to jobs on the basis of direct-labor hours. The result is that all costs and expenses incurred during any month are charged to work-in-process accounts for the jobs.

1. You are to compare this system, as it affects inventory valuation, with the usual system for manufacturing businesses.
2. You are to criticize the system as it affects inventory valuation and income determination.
3. You are to state any justification which you see for the use of the H Company's system.

(AICPA)

**7-12** *Job-order costing.* The Rockland Corporation maintains a factory and a general ledger. The company's postclosing trial balance, after elimination of the reciprocal accounts, as at December 31, 1964, is presented below:

### THE ROCKLAND CORPORATION

#### Postclosing Trial Balance

As at December 31, 1964

Cash.....	\$ 38,000	
Accounts receivable.....	126,000	
Stores (factory ledger).....	43,000	
Work in process (factory ledger).....	29,000	
Finished goods (factory ledger).....	-0-	
Fixed assets.....	200,000	
Allowance for depreciation.....		\$ 40,000
Payroll taxes payable.....		1,800
Income taxes withheld.....		2,600
Accounts payable.....		92,000
Common stock.....		100,000
Earned surplus.....		199,600
<b>Total.....</b>	<b>\$436,000</b>	<b>\$436,000</b>

Work in process consisted of three jobs, with the following balances:

Job 100.....	\$ 8,000
Job 101.....	12,000
Job 102.....	9,000
Total.....	<u>\$29,000</u>

The following transactions occurred during January:

1. Raw materials and factory supplies ordered, received, paid for, and used in January were as follows:

	<i>Raw materials</i>	<i>Supplies</i>	<i>Total</i>
Ordered.....	\$63,000	\$14,000	\$77,000
Received.....	58,000	12,000	70,000
Paid for.....	66,000	16,000	82,000
Used.....	49,000	8,000	57,000

Supplies were used in the amount of \$3,000 in Producing Department A, \$4,000 in Producing Department B, and \$1,000 in the power plant. Materials were used on jobs as follows:

Job 100.....	\$ 8,000
Job 101.....	24,000
Job 102.....	11,000
Job 103.....	6,000
Total.....	<u>\$49,000</u>

2. A summary of the payroll for the month follows:

	<i>Dept. A</i>	<i>Dept. B</i>	<i>Power plant</i>	<i>Selling and administration</i>
Direct labor.....	\$18,000	\$14,000	-0-	-0-
Indirect labor.....	4,000	3,000	\$6,000	\$4,000
Overtime premium.....	2,000	1,000	-0-	-0-
Gross payroll.....	<u>\$24,000</u>	<u>\$18,000</u>	<u>\$6,000</u>	<u>\$4,000</u>
Payroll taxes:				
F.I.C.A.....	\$ 760	\$ 620	\$ 210	\$ 170
Unemployment compensation...	600	450	180	100
Total.....	<u>\$ 1,360</u>	<u>\$ 1,070</u>	<u>\$ 390</u>	<u>\$ 270</u>

Payroll taxes and overtime premium are treated as factory overhead (or selling and administrative expense). Social security tax, union dues (\$175),



and withholding tax (\$8,000) are deducted from employees' checks. The direct labor was applicable to jobs as follows:

<i>Job number</i>	<i>Dept. A</i>	<i>Dept. B</i>
100	\$ 4,000	\$ 3,000
101	3,000	3,000
102	10,000	7,400
103	1,000	600
	<u>\$18,000</u>	<u>\$14,000</u>

3. During the month, the company paid payrolls in the amount of \$40,000, payroll taxes in the amount of \$1,800, and income tax withheld \$2,600.
4. Additional expenses paid or accrued during the month were:

	<i>Dept. A</i>	<i>Dept. B</i>	<i>Power plant</i>	<i>Selling and administration</i>	<i>Total</i>
Repairs (cash).....	\$ 800	\$1,500	\$ 600	\$ 300	\$ 3,200
Maintenance (cash).....	1,400	200	800	300	2,700
Taxes (accrued).....	400	300	200	200	1,100
Depreciation.....	1,900	1,500	1,600	400	5,400
Insurance (accrued).....	200	100	100	50	450
Total.....	<u>\$4,700</u>	<u>\$3,600</u>	<u>\$3,300</u>	<u>\$1,250</u>	<u>\$12,850</u>

5. The power plant's predetermined billing rate is 30 cents per kilowatt-hour used. Department A applies overhead at 100 percent of direct labor. Department B applies overhead at \$1.50 per machine hour.
6. Production statistics were as follows:

	<i>Dept. A</i>	<i>Dept. B</i>
Kwhr used.....	200,000	150,000
Machine hr:		
Job 100.....	2,000	2,500
Job 101.....	3,000	3,000
Job 102.....	8,000	7,000
Job 103.....	1,000	500
	<u>14,000</u>	<u>13,000</u>

7. Jobs 102 and 103 were completed and shipped to customers at sales prices of \$99,000. Over- or underapplied overhead is closed out to cost of sales.
8. Customers paid bills amounting to \$140,000.

*Required:*

1. Record the foregoing transactions in T accounts, keeping the factory and general ledgers separate.
2. Prepare trial balances of the two ledgers as of the end of January and a trial balance of the subsidiary job ledger.
3. Prepare an income statement for the month.

7-13

*Job-order costing.* Machined Products, Inc., showed the following balances in its factory ledger as of January 31, 1965. Factory Overhead and Factory Overhead Applied are closed out each month to Cost of Sales.

Stores	54,000	
Work in Process	81,000	
Factory Overhead Control	-0-	
Factory Overhead Applied		-0-
General Ledger		135,000
Totals	<u>135,000</u>	<u>135,000</u>

The subsidiary Stores records showed the following:

Material X, 10,000 units @ \$2  
 Material Y, 5,000 units @ \$6  
 Supplies, \$4,000

The subsidiary job ledger contained the following:

<i>Job number</i>	<i>Materials</i>	<i>Labor</i>	<i>Applied overhead</i>	<i>Total</i>
150	\$ 4,000	\$ 3,600	\$ 5,400	\$13,000
153	11,500	9,000	13,500	34,000
154	5,500	5,000	7,500	18,000
156	6,000	4,000	6,000	16,000
	<u>\$27,000</u>	<u>\$21,600</u>	<u>\$32,400</u>	<u>\$81,000</u>

During the month of February, the following transactions occurred:

## 1. Purchases

X, 3,000 units @ \$2.10 (Feb. 15)  
 4,000 units @ \$2.20 (Feb. 27)  
 Y, 2,000 units @ \$5.75 (Feb. 18)  
 Supplies, \$3,000

2. The company uses the Lifo basis for costing inventories. Of the total cost of materials used in February, 10 percent applied to Job 150, 40 percent to Job 153, 20 percent to Job 154, and 30 percent to Job 156. Supplies used amounted to \$6,600.
3. Labor incurred during February was as follows: Direct labor \$22,000 (Job 150 \$4,400, Job 153 \$8,000, Job 154 \$6,000, Job 156 \$3,600). Overtime premium and payroll taxes were \$1,900, and indirect labor \$3,000.
4. Other overhead costs amounted to \$24,000.

5. Jobs 150 and 154 were completed and shipped to customers.  
 6. Inventory of raw materials on February 28, consisted of:

Material X, 3,500 units  
 Material Y, 2,200 units

*Required:* Record all journal entries for transactions affecting the factory ledger.

7-14

*Job-order costing.* The Kentucky Slugger Company manufactures baseball bats to order. The plant is divided into three departments, turning, finishing, and general plant. The predetermined overhead rate for the turning department is 100 percent of direct labor and for the finishing department 150 percent of direct labor.

The turning department occupies 5,000 square feet of space, the finishing department 3,000, and the general-plant department 1,000. Machinery and equipment in the turning department are valued at \$8,000; in the finishing department \$2,000, and in the general plant \$2,000. The horsepower ratings are 40 in turning, 10 in finishing, and 10 in general plant. Compensation insurance is paid at the rate of \$2 per \$100 of wages. Stores on January 1, 1965, consisted of the following:

Ash, 3 × 3, 6,000 pcs. @ \$.50	\$3,000
Ash, 2 × 3, 4,000 pcs. @ \$.30	1,200
Supplies	1,000
	<u>\$5,200</u>

The voucher register contained the following entries: raw materials purchased \$2,700 (3,000 pcs. 3 × 3 ash \$1,500; 4,000 pcs. 2 × 3 ash \$1,200), rent \$250, heat and light \$100, power \$200, compensation insurance prepaid \$400, supplies \$600, accrued wages \$5,600, and general office expense \$500.

The sales journal showed the following:

Job 25	1,500 units	\$6,750
Job 26	2,000 units	6,000
Job 27	2,950 units	8,850

The labor distribution summary showed the following: direct labor \$6,000; indirect labor, turning \$1,800, finishing \$1,400, and general plant \$300.

Direct labor is distributed as follows:

Job number	Turning	Finishing
25	\$1,500	\$ 800
26	1,000	400
27	800	500
28	700	300
	<u>\$4,000</u>	<u>\$2,000</u>

Orders 25 and 26 use 3 × 3 ash, and Orders 27 and 28 use 2 × 3 ash.

There was no work in process at the beginning of the month. Of the four orders started during the month, three are completed; Order 28 still is in

process at the end of the month. On Order 25, which calls for 1,600 bats, 1,500 were shipped, and 100 were spoiled. The spoiled bats are returned to the stockroom. They will later be turned into junior league bats for Order 28. However, it will cost an additional 80 cents per bat to rework them. Orders 26 and 27 were completed and shipped. Order 27 called for 3,000 bats, but 50 were spoiled and are not recoverable. Order 28 calls for 4,000 bats at \$3 each. Only one-fourth of this order is being worked on at present.

Other overhead costs are as follows:

Depreciation on machinery	\$ 200
Taxes accrued	50
Supplies consumed (turning \$800, finishing \$1,200, and general plant \$200)	2,200

General-plant supplies are allocated to producing departments on the basis of supplies used directly by them.

Required:

1. Record all journal entries.
2. Prepare an income statement.

7-15

*Flow of costs in job-order system.* The Radio Company of Detroit was engaged in the manufacture of radio receiving sets, accessories, etc. A job cost system was in use.

The trial balance of the production ledger as of May 31, 1962, was as follows:

**THE RADIO COMPANY OF DETROIT**  
Production-ledger Trial Balance  
As of May 31, 1962

	Debit	Credit
General stores control	\$ 9,262.08	
Work-in-process control	7,024.02	
Receiving and storeroom expense	638.92	
General factory overhead	3,993.36	
Finished stock control	3,873.96	
Accrued payroll		\$ 406.98
General-ledger control		24,385.36
	<u>\$24,792.34</u>	<u>\$24,792.34</u>

The balances in the work-in-process ledger as of May 31, 1962, were as follows:

**Balances in Work-in-process Ledger**  
As of May 31, 1962

Job number	Machine hours	Labor cost	Materials cost	Total cost
876	941	\$ 978.73	\$ 908.72	\$1,887.45
879	1,087	1,101.72	1,168.90	2,270.62
882-889	2,307	2,176.47	689.48	2,865.95
	4,335	\$4,256.92	\$2,767.10	\$7,024.02

During June, 1962, invoices were entered in the purchase book on account of factory as follows:

For general stores.....	\$4,102.58
For general factory purposes.....	450.00
For receiving and storeroom expense.....	367.92

Payrolls accrued during the month on account of factory were as follows:

Direct labor:	
Job 876.....	\$ 19.87
Job 879.....	117.48
Jobs 882-889.....	875.97
Job 890.....	402.93
Indirect labor:	
Receiving and storeroom.....	\$187.82
General factory.....	193.09

Payments made during the month for factory payrolls were \$2,201.98  
Deferred charges (insurance, etc.) written off the general ledger during the month on account of the factory were as follows:

For receiving and storeroom.....	\$112.72
For general factory.....	62.93

Depreciation applicable to the factory was as follows:

Receiving and storeroom.....	\$ 2.01
General factory overhead.....	190.66

Requisitions on the general storeroom during the month amounted to \$6,406.93, of which \$201.87 was for general factory uses and \$6,205.06 was for jobs, as follows:

Job 879.....	\$ 601.72
Jobs 882-889.....	3,000.70
Job 890.....	2,602.64

The machine hours during the month on jobs were as follows:

Job 876.....	31 hr
Job 879.....	127 hr
Jobs 882-889.....	700 hr
Job 890.....	351 hr

Jobs completed during the month were:

Job 876  
Job 879  
Job 882-889

Job 876 was shipped direct to a customer from the factory floor and did not pass through the finished stockroom. Job 879 represented receiving sets which went into the finished stockroom, and Jobs 882 to 889 represented component parts which went into general stores.



Overhead on jobs was distributed at the time the job was completed and closed out. The rates were as follows:

Receiving and storeroom expense, 6% of cost of material issued from stores  
General factory overhead, 80 cents per machine hr used on job

In addition, the receiving and storeroom expenses applicable to general-stores issues for purposes other than for jobs is distributed monthly to the account or accounts for which the material is withdrawn. The rate is 6 percent of the value of such material withdrawn from general stores.

In addition to the sale of Job 876, materials costing \$7,087.09 were shipped from the finished stockroom, and materials costing \$2,108.09 were shipped from the general storeroom.

Owing to the illness of the bookkeeper, your assistance was requested in writing up and closing the books for the month of June, 1962. All the foregoing transactions with the exception of the entries affecting cost of goods sold had been entered on the general books.

The production-ledger control on the general books was as follows:

Production-ledger Control		
1962	June	
	1, Balance.....	\$24,385.36
	30, Purchases.....	4,920.50
	30, Payroll.....	2,201.98
	30, Deferred charges.....	175.65
	30, Depreciation.....	192.67

No entries, however, had been made on the production journal or production ledger.

On the basis of the above facts, prepare:

1. Journal entries for the production journal.
2. Trial balance of the production ledger.
3. Schedule of accounts in work-in-process ledger as of June 30, 1962.

(AICPA)

7-16

*Analysis of variances between actual and estimated cost of jobs.* You are auditing the accounts of the McGovern Book Publishing Company. Four jobs were worked on during the month ending January 31, 1965. The company's work-in-process and overhead accounts appear as shown below:

Work in Process		
Materials	46,682	52,500
Direct labor	3,285	
Overhead	4,160	

Factory Overhead	
4,680	

Factory Overhead Applied	
	4,160

The income statement prepared by the company's chief accountant was as follows:

### McGOVERN BOOK PUBLISHING COMPANY

#### Income Statement

Month Ended January 31, 1965

Sales.....	\$73,000
Cost of sales.....	52,500
Gross profit.....	<u>\$20,500</u>
Less: Selling and administrative expenses.....	15,000
Income.....	<u>\$ 5,500</u>

You find the following details in the subsidiary job ledger. Cost estimates represent what management believes the costs should be.

#### Subsidiary Job-order Data

	<i>Estimated costs</i>		<i>Actual costs</i>	
<b>Job 100 (price \$16,000)—complete:</b>				
Materials.....	(100 units @ \$65)	\$6,500	(102 units @ \$66)	\$6,732
Labor.....	(200 hr @ \$3)	600	(210 hr @ \$3.10)	651
Overhead.....	(200 hr @ \$4)	800	(210 hr @ \$4)	840
		<u>\$7,900</u>		<u>\$8,223</u>
<b>Job 101 (price \$35,000)—complete:</b>				
Materials.....	(300 units @ \$80)	\$24,000	(280 units @ \$82)	\$22,960
Labor.....	(500 hr @ \$3)	1,500	(480 hr @ \$3.30)	1,584
Overhead.....	(500 hr @ \$4)	2,000	(480 hr @ \$4)	1,920
		<u>\$27,500</u>		<u>\$26,464</u>
<b>Job 102 (price \$22,000)—complete:</b>				
Materials.....	(250 units @ \$60)	\$15,000	(280 units @ \$60)	\$16,800
Labor.....	(300 hr @ \$3)	900	(320 hr @ \$3)	960
Overhead.....	(300 hr @ \$4)	1,200	(320 hr @ \$4)	1,280
		<u>\$17,100</u>		<u>\$19,040</u>
<b>Job 104 (price \$25,000)—incomplete:</b>				
Materials.....	(200 units @ \$90)	\$18,000	(20 units @ \$95)	\$190
Labor.....	(400 hr @ \$3)	1,200	(30 hr @ \$3)	90
Overhead.....	(400 hr @ \$4)	1,600	(30 hr @ \$4)	120
		<u>\$20,800</u>		<u>\$400</u>

The overhead rate of \$4 per hour is calculated as follows:

Budgeted monthly level.....	1,000 hr
Budgeted fixed costs.....	\$3,000
Budgeted variable costs.....	<u>1,000</u>
Total budgeted overhead.....	<u>\$4,000</u>
Budgeted overhead rate.....	\$4 per hr

**Required:**

1. Prepare a revised profit and loss statement that will conform to accepted accounting principles and will disclose to management the causes for differences between actual and estimated costs on jobs completed and shipped during the month. (*Hint:* The statement should show the effect of actual prices of materials varying from the estimated prices, the effect of using more or fewer materials than estimated, the effect on profits of labor rate variances and labor efficiency, and the overhead budget and volume variances.)
2. Record any journal entries necessary to correct the accounts.

## **8. Process Cost Accounting**

In the preceding chapter, the job-order cost accounting system, which is appropriate for production activities which are in the nature of separate, usually dissimilar projects, was described. In this chapter, process cost accounting is considered. In the process type of manufacturing, relatively standardized products are made for stock rather than for specific customers, according to their specifications. Because of the diversification of activities by business firms, it is becoming more difficult to define industries and to classify their activities as either the job-order type or process type. Hence, any given firm which is diversified may have activities of either type.

### **Production processes**

It may be contended that firms should strive to change from job-order production to process production whenever this is possible because the process arrangement is more stable, standardized, and therefore more efficient. Planning, performing, and controlling activities may be easier and require less managerial attention when units of products are standardized and processes are continuous than when units of product are differentiated and production processes are intermittent.

An example of changing from job order to process is that of soap companies, which made the switch when technological developments changed the time required to manufacture a batch of soap from several days to a few hours. The American phenomenon of mass production of standardized products for mass consumption has increased the importance of the process type of production. Engineering efforts to standardize and routinize production activity by men and machines has accompanied this standardization of products. Technological improvements also have reduced the length of time necessary to convert raw materials into finished products.

In this chapter the process cost discussion relates to production activities which are in the nature of continuous production of rather standardized products. The concepts introduced in this chapter should

provide a basic understanding of the nature of process cost accounting and sufficient background for dealing with more complex process cost applications.

A process is an organizational entity or section of the firm in which specific, rather specialized, and repetitive work is done. Some of the various other terms used to describe a process are department, cost center, responsibility center, function, and operation. Some examples of processes are subassembly, assembly (or fabrication), sanding, painting, milling, polishing, glazing, blasting, and finishing.

Any one process may be utilized for the manufacture of several products. Also, any one product may require processing through several processes. The particular production arrangement depends upon the technical engineering features of product and process design.

The nature of product and process design, in addition to factory organization and layout, determines the relationship of processes to each other, such as whether processes are arranged as *sequential processes* or as *parallel processes*. Parallel processes operate independently of each other. The output of one such parallel process does not become the raw material or input for another parallel process. When a process receives the output of another process and further processes it, the two processes are in a sequential process arrangement.

### Overview of process cost accounting

Prior to discussing in depth the features of a process cost accounting system, it is well to recall briefly the over-all picture of such a system and its use for the two major purposes of management control and product costing. In process cost accounting, the emphasis is upon accumulating costs for a period of time such as a month by processes, or departments, functions, cost centers, for which a manager is responsible. This is in contrast to the job-order emphasis upon accumulating costs by jobs or batches of product.

Costs which are direct with respect to processes or departments are the important ones for control purposes. Costs which are directly related to product ordinarily also are directly related to processes. Direct product costs such as direct materials, direct labor, and direct factory overhead usually also can be related directly to the department or process in which they are incurred. For product-costing purposes, however, costs which are indirectly related to processes are allocated to processes on some reasonable basis.

After costs have been accumulated for each department or process, management information and control reports are prepared. The costs for which each process or department manager is responsible are compared with some yardstick of performance such as budget allowances, standard costs, or past periods' results. Management then makes efforts to get into control those situations which are "out of control."



After control information has been obtained from the cost accounts, all elements of production cost including those indirect costs which have been allocated to processes are "pushed" through the process accounts for the purpose of determining total manufacturing cost of products completed. The beginning work-in-process inventory plus the three elements of production cost (materials, labor, and overhead) which are put into a process during a period of time must be accounted for.

After attaching incurred production costs to products, they are accounted for either as cost of goods processed and sent to the next process or to finished goods inventory, or as ending work-in-process inventory. The flow of costs through the accounts is accomplished by crediting one process and debiting the next process (or finished goods) for the cost of goods transferred. The balances remaining in the process accounts make up the work-in-process inventory.

Costs per unit of product are obtained by dividing the units of goods manufactured or processed into the cost of goods manufactured or processed. These unit costs are pyramided as they pass from department to department in a sequential process situation, so that the finished product bears the cumulative cost of all the operations performed on it. Such product cost data then are used in income determination, inventory costing, and in management decision making such as setting selling prices.

### Work-in-process inventory in process cost accounting

In job-order cost accounting, the cost of work-in-process inventory is determined simply by referring to the balance in the Work in Process account, which is supported by job cost sheets. In process cost accounting systems, job cost sheets are not maintained, and the day-to-day emphasis is upon assigning costs, not to products, but rather to the processes or departments in which costs are incurred. In process cost accounting, the task of determining work-in-process inventory at any time is somewhat more complex. Most of the remainder of this chapter deals with this problem.

Some of the complexity of determining the cost of work-in-process inventory is due to the fact that uncompleted production may be located within any of or all the production processes as well as between processes in a sequential process arrangement. For convenience, *between-process* inventories are regarded as *in-process* inventories of the preceding process. Calculations of the various inventories must be made and added together to constitute the total work-in-process inventory to be used on the statement of cost of goods manufactured and the balance sheet.

In order that production costs may be attached either to the goods completed and transferred from a process or to those which make up the ending work-in-process inventory, it must be known how materials are

added to production. In general, materials may be added to a product at the beginning of the processing stage, continuously throughout processing, at certain stages of completion or at the end of the processing stage.

Direct-labor and factory-overhead costs ordinarily are assumed to be added (or attached to product) uniformly throughout processing. In this book, such an assumption always will be made. Since labor and overhead costs are assumed to attach in the same pattern, the term "conversion cost," which is the term for the combination of the two, will be used frequently. Other expressions with the same meaning as conversion cost are "processing cost" and "operation cost."

### *Process cost illustration*

The hypothetical Arbuckle Company will be used to demonstrate process cost accounting. Assume that materials A and B are assembled into semifinished goods X in a process called Process 1 and that materials C and D are assembled into semifinished goods Y in a process labeled Process 2. Semifinished products X and Y are then completed in Process 3 as finished goods X and Y.

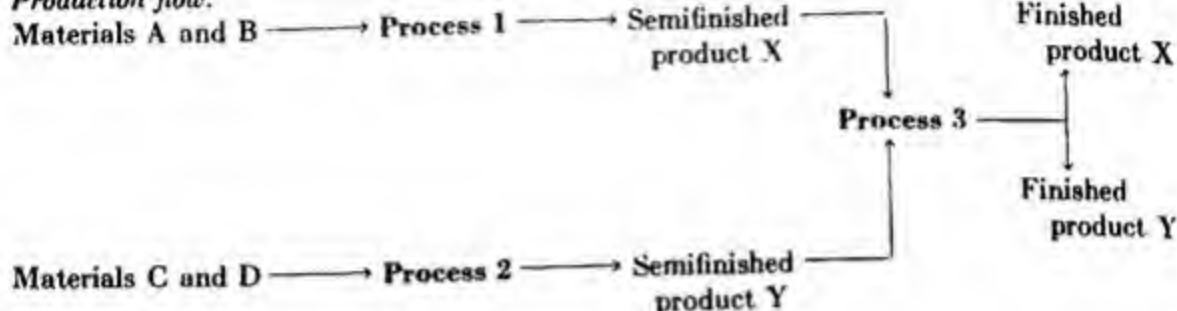
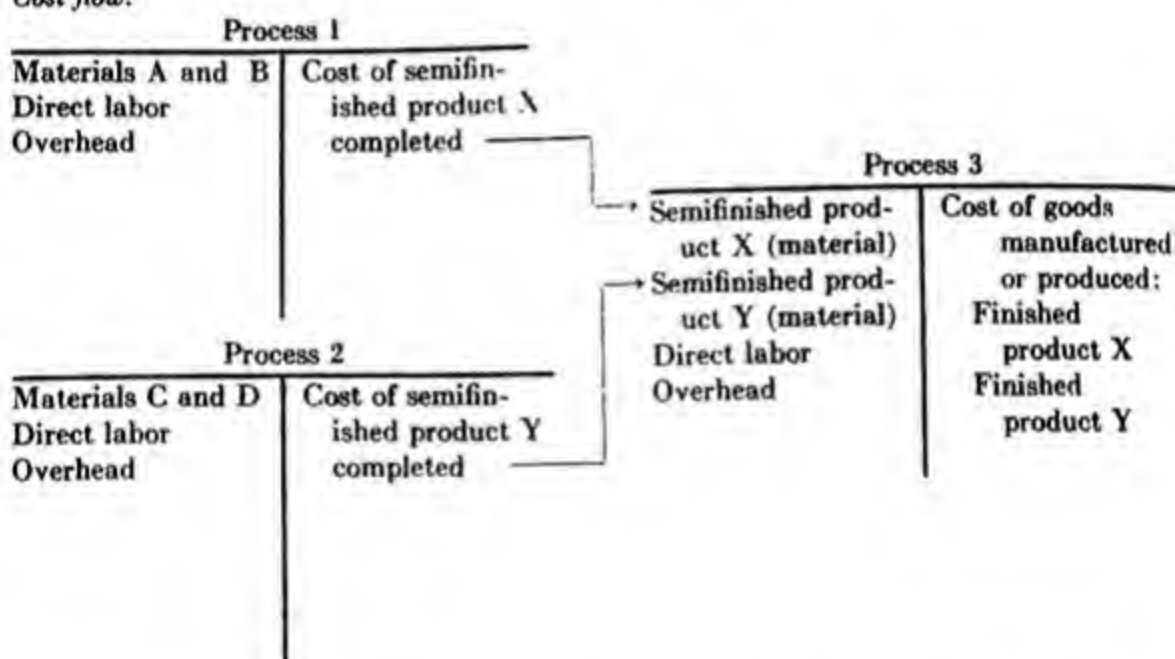
The relationship of Processes 1 and 2 is parallel. The relationship of Processes 1 and 3, and of Processes 2 and 3 is sequential. Semifinished goods X, which is the output of Process 1, is the material input for Process 3. Similarly, the output of Process 2 (semifinished goods Y) is the material input for Process 3. Under a sequential process arrangement, for purposes of tracing the flow of costs through the cost accounts and building up product costs, it is necessary to deal with the cost accounts in their sequence. In other words the cost of the output of Process 1 must be calculated first, because this becomes the material input cost for Process 3. On the other hand, the costs of the output of Processes 1 and 2 can be computed at the same time and independently of each other. Any given firm may have some of its processes in a parallel arrangement and some in a sequential arrangement.

It is very helpful in studying production processes and process cost systems to sketch the flow of production in a diagram. Since, for product-costing purposes, the material, labor, and overhead costs are attached, or applied, to production, these costs flow through the cost accounts in the same way that production flows through the processes. The Arbuckle Company example is diagrammed in Exhibit 8-1.

Using the process cost arrangement of the Arbuckle Company, assume the following activity for the month of January: there was no work-in-process inventory in or between any processes at the beginning of the month; materials A and B are added at the beginning of processing in Process 1; materials C and D are added at the beginning of processing

## Exhibit 8-1

**THE ARBUCKLE COMPANY**  
Flow of Production and Costs

*Production flow:**Cost flow:*

in Process 2. As mentioned previously, the services and therefore the costs of labor and overhead items in all processes are assumed to be added uniformly throughout processing in those processes.

Because of the sequential arrangement of Processes 1 and 2 with Process 3, the output of these two processes (semifinished products X and Y) is the material input for Process 3 and is assumed to be added at the beginning stage of processing in Process 3. One unit of semifinished product X becomes one unit of finished product X; one unit of semifinished product Y becomes one unit of finished product Y.

In January, Process 3 was devoted entirely to processing semifinished product X into finished product X. The production of semifinished product Y was stockpiled as a between-process inventory. The output of each process is counted as it leaves the process.

January activity was as follows:

Materials used:	
Material A used.....	\$ 1,400
Material B used.....	2,200
Material C used.....	1,800
Material D used.....	1,600
Direct labor incurred:	
In Process 1.....	\$ 8,000
In Process 2.....	6,000
In Process 3.....	12,000
Factory overhead incurred:	
Direct:	
Process 1.....	\$ 1,600
Process 2.....	2,000
Process 3.....	4,000
Indirect (allocated to processes):	
Process 1.....	\$ 6,000
Process 2.....	6,000
Process 3.....	16,000
Units of semifinished product X produced.....	10,000
Units of semifinished product Y produced.....	6,000
Units of finished product X produced.....	8,000

There is no ending work-in-process inventory in either Process 1 or Process 2, and none between Process 1 and Process 3. There were no spoiled, defective, or wasted units in any process. The ending inventory in Process 3 therefore consists of product X and when completed will amount to 2,000 units of product X. Since these units have not been completed, an inspection (usually in cooperation with engineers) is made to estimate, on the average, how near to completion the unfinished production is. In the Arbuckle illustration, it is estimated that all work in process in Process 3 is, on the average, one-half finished.

Prior to tracing the flow of costs through the accounts, the cost accounts appear as shown in Exhibit 8-2.

**Tracing the flow of costs through the accounts—Processes 1 and 2**  
The task of attaching costs and tracing them through the accounts is identical in Processes 1 and 2. Since there is no beginning or ending work-in-process inventory in either process, the total cost of output is the same as the total of cost inputs in each process. Therefore, the cost of the 10,000 units of semifinished product X processed and sent to Process 3 amounts to \$19,200 (\$1.92 per unit of output); the cost of the 6,000 units of finished product Y processed and stockpiled as an inventory between processes amounts to \$17,400 (\$2.90 per unit of output).

The entries to reflect this flow of costs are:

Process 3.....	19,200	
Process 1.....		19,200
Semifinished Y.....	17,400	
Process 2.....		17,400





The balances remaining in Process 1 and Process 2 are ending work-in-process inventories amounting in this case to zero.

### Tracing the flow of costs through the accounts—Process 3

The task of attaching costs to product and tracing costs through Process 3 is somewhat more complex because of the ending work-in-process inventory which is one-half finished. The fact that there is no beginning work-in-process inventory is a simplifying factor. The cost of semi-finished product X (\$19,200) which is started in process is a materials cost in Process 3. This cost, plus the conversion costs (labor and overhead) assigned to Process 3, must be split up between two batches of product: (1) the 8,000 units which were completed and sent to finished goods and (2) the half-finished units in the ending work-in-process inventory which, when finished, will amount to 2,000 units.

Since materials (semifinished X) are added at the beginning of the processing stage and the conversion elements are assumed to be added uniformly throughout processing, the two types of cost must be treated separately and differently. The total materials cost of \$19,200 must be allocated between the 8,000 units and the 2,000 units of product X. Since the 2,000 units also are complete as far as materials are concerned, the 8,000 and the 2,000 are referred to as *actual units* for purposes of attaching materials cost. Because all 10,000 units are complete with respect to materials, these units in both batches of product are given a "full shot" of materials cost as follows:

$$\begin{array}{rcl}
 \$19,200 \div 10,000 \text{ actual units} & = & \$1.92 \text{ per actual unit} \\
 8,000 \text{ actual units} \times \$1.92 & = & \$15,360 \\
 2,000 \text{ actual units} \times \$1.92 & = & 3,840 \\
 & & \hline
 & & \$19,200
 \end{array}$$

Thus, the materials element of the cost of the 8,000 units of product X completed and sent to finished goods amounts to \$15,360; the materials element of the cost of the 2,000 uncompleted units of product X constituting the ending work-in-process inventory in Process 3 amounts to \$3,840.

The Process 3 conversion costs of \$32,000 have been incurred this period (1) to start and finish the processing of 8,000 units and (2) to start and bring to the 50 percent completion stage the 2,000 units still in process. The 2,000 units are in terms of actual completed units; i.e., this batch will amount to 2,000 units when completed.

An *equivalent units of production* (rather than actual units) basis must be used for assigning conversion costs to the two groups of product. The 2,000 units which are one-half finished are the equivalent of 1,000 completely finished. Therefore, the ending work-in-process inventory, when dealing with the conversion-cost element, amounts to 1,000 equivalent units. For the 8,000 units which were both started and finished this period, the equivalent units are the same as the actual units, namely,

8,000. Total equivalent units of production obtained this period for conversion-cost purposes amount to 9,000, which is the basis for allocating the \$32,000 conversion costs to the goods finished and to the ending work-in-process inventory. The allocation is as follows:

\$32,000 ÷ 9,000 equivalent units = \$3.5556 per equivalent unit
8,000 equivalent units × \$3.5556 = \$28,444
1,000 equivalent units × 3.5556 = 3,556
\$32,000

The conversion-cost element of the cost of product X completed and transferred is \$28,444; the conversion-cost element of the ending work-in-process inventory is \$3,556.

The total cost of product X completed is \$43,804 (\$15,360 materials cost + \$28,444 conversion cost). The total cost of the ending work-in-process inventory is \$7,396 (\$3,840 materials cost + \$3,556 conversion cost). The entry to effect the flow of costs is:

Finished Goods (Product X) .....	13,804	
Process 3 .....		13,804

This leaves a balance of \$7,396 as the work-in-process inventory in Process 3.

On external financial statements, the \$17,400 inventory of semifinished Y is considered to be a part of work-in-process inventory, since it is not yet a finished product.

### Unit cost of products

The unit cost of goods completed amounts to \$5.4755 (\$43,804 ÷ 8,000), as does the cost per equivalent unit of the ending work-in-process inventory (\$1.92 material cost + \$3.5556 conversion cost). The \$5.4755 unit cost (expressed in terms of output, rather than input) is a cumulative cost which was built up, or synthesized, as follows:

Process 1:		
Material A .....	\$ 14	(\$1,400 ÷ \$10,000)
Material B .....	22	(\$2,200 ÷ \$10,000)
Conversion costs:		
Direct labor .....	.80	(\$8,000 ÷ \$10,000)
Direct overhead .....	.16	(\$1,600 ÷ \$10,000)
Indirect overhead .....	.60	(\$6,000 ÷ \$10,000)
Total .....	\$1.92	
Process 3:		
Conversion costs:		
Direct labor .....	\$1.3333	(\$12,000 ÷ \$9,000)
Direct overhead .....	.4444	(\$4,000 ÷ \$9,000)
Indirect overhead .....	1.7778	(\$16,000 ÷ \$9,000)
Total .....	\$3.5555	
Total .....	\$5.4755	

**THE ARBUCKLE COMPANY**  
Process Cost Accounts

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The Arbuckle Company cost accounts are presented in Exhibit 8-3 after the entries have been made in the accounts for the flow of production through the processes and the flow of costs through the cost accounts.

In Exhibit 8-4, a process cost report is presented for the Arbuckle Company. A process cost report accounts for the flow of units and costs within and between processes. This report is used by the cost accounting department as the basis for preparing journal entries. Ordinarily, it is not issued to factory management, at least in this form. It will be noted that the 10,000 units finished in Process 1 have been transferred to Process 3 at a cost of \$19,200. The units completed in Process 2 have

*Exhibit 8-4*

THE ARBUCKLE COMPANY  
Process Cost Report  
Month of January

	Process 1		Process 2		Process 3	
	Total cost	Unit cost	Total cost	Unit cost	Total cost	Unit cost
Costs to be accounted for:						
In-process inventory	-0-		-0-		-0-	
From prior department	-0-		-0-		\$19,000	\$1.92
Materials added	3,600	\$ .36	\$ 3,400	\$ .567	-0-	-0-
Conversion costs	15,600	1.56	14,000	2.333	32,000	3.5555
Total	\$19,200	\$1.92	\$17,400	\$2.900	\$51,200	\$5.4755
Costs accounted for:						
Goods completed	\$19,200		\$17,400*		\$43,804	
In-process inventory	-0-		-0-		7,396	
Total	\$19,200		\$17,400		\$51,200	
Units to be accounted for:						
In-process inventory	-0-		-0-		-0-	
From prior department	-0-		-0-		10,000	
New units added	10,000		6,000		-0-	
Total	10,000		6,000		10,000	
Units accounted for:						
Completed	10,000		6,000		8,000	
In process	-0-		-0-		2,000	
Total	10,000		6,000		10,000	
Equivalent units produced:						
Materials	10,000		6,000		10,000	
Conversion costs	10,000		6,000		9,000	

\* Stockpiled.

not been transferred to Process 3, since they are being stockpiled. They also might be reported as "goods completed and *not* transferred" in Process 2.

The Arbuckle Company example illustrates the general features of a process cost accounting system. The following process cost situations were included:

1. The flow of production and of costs through the accounts in sequential and parallel process arrangements
2. The phenomenon of between-process inventories
3. The assignment of process costs to production completed or transferred and to the ending work-in-process inventory which is only partially processed, where materials are added at the beginning stage of processing and under the usual assumption that conversion costs are added constantly and uniformly throughout processing
4. The concept of *equivalent* units of production in assigning conversion costs to goods completed and to the ending (incomplete) work-in-process inventory

### Process cost complexities

The more complex aspects of process costing may now be considered. They include (1) beginning as well as ending inventories of work in process, (2) the addition of materials at different stages of process, (3) the effect of using FIFO, LIFO, and weighted-average inventory costing methods, and (4) accounting for units lost in process.

#### Beginning and ending inventories partially completed

Using the Arbuckle Company Process 1 only, assume that in a later month the process account appeared as shown in Exhibit 8-5.

Exhibit 8-5

#### THE ARBUCKLE COMPANY Process Cost Account

##### Process 1

Beginning inventory (10,000 product units, one-half completed):		Accounted for as:	
Materials A and B	3,600	Semifinished X completed (25,000 product units)	
Conversion costs	7,800	Ending inventory (5,000 product units, four-fifths completed)	
Materials A and B	7,200		
Direct labor	16,000		
Direct overhead	3,200		
Indirect overhead	12,000		
Costs to account for	49,800		49,800



Assume a beginning inventory in Process 1 of 10,000 units, one-half completed, and an ending inventory of 5,000 units 80 percent completed. It will be recalled that materials are added at the beginning of processing while labor and overhead are added continuously throughout processing. The cost problem is to assign the \$49,800 to the product completed and to the ending inventory, based on the use of *Fifo*.

Since materials are added at the beginning of processing, both the ending inventory and the goods completed (as well as the beginning inventory) are complete with respect to materials. Thus, materials cost of \$7,200 results in 20,000 units of production ( $25,000 + 5,000 - 10,000$ ), or a unit cost for materials used this period of 36 cents.

Since conversion costs attach continuously throughout processing and the beginning and ending inventories are only partially processed, equivalent units of production must be used to cost the ending inventory and the products completed and transferred.

During the month, conversion costs of \$31,200 were incurred to accomplish the following:

1. Finish the 10,000 units which were half finished in the beginning inventory.

2. Start and finish 15,000 units.

3. Start and process to the 80 percent stage of completion the 5,000 uncompleted units in the ending inventory.

The equivalent units of production, which are the basis for attaching the \$31,200 conversion costs to these three batches of product, are, respectively:

1. Five thousand equivalent units. Completing the second half of "converting," or processing, 10,000 units is the equivalent of doing all the converting, or processing, of 5,000 units.

2. Fifteen thousand equivalent units. Since these units were both started and finished during the period, the equivalent units are the same as the actual units.

3. Four thousand equivalent units. Bringing 5,000 units to the 80 percent stage of completion is the equivalent of doing all the necessary processing of 4,000 units.

Total equivalent units amount to 24,000 and the conversion costs incurred during the month amount to \$31,200. The conversion cost amounts to \$1.30 per equivalent unit.

Costs now may be attached to the 25,000 units completed and transferred and the 5,000 units still in process, as shown below:

Units completed and transferred:

10,000 @ \$11.40 + $\frac{1}{2}(10,000 \times \$1.30)$ ..	\$17,900	
15,000 @ \$1.66 ..	24,900	\$42,800

Units still in process (80% complete):

5,000 @ \$.36 + .8 (5,000 $\times$ \$1.30) ..	7,000	
Total costs accounted for ..		<u>\$49,800</u>

## Exhibit 8-6

**THE ARBUCKLE COMPANY**  
**Process 1 Cost Report**

	<i>Total cost</i>	<i>Unit cost</i>
Costs to be accounted for:		
In-process inventory.....	\$11,400	
Materials added.....	7,200	\$ .36
Conversion costs.....	31,200	1.30
Total.....	<u>\$49,800</u>	<u>\$1.66</u>
Costs accounted for:		
Goods completed.....	\$42,800	
In-process inventory.....	7,000	
Total.....	<u>\$49,800</u>	
Units to be accounted for:		
In process.....	10,000	
New units added.....	20,000	
Total.....	<u>30,000</u>	
Units accounted for:		
Completed.....	25,000	
In process.....	5,000	
Total.....	<u>30,000</u>	
Equivalent units produced:		
Materials.....	20,000	
Conversion costs.....	24,000	

The process cost report reflecting this activity appears in Exhibit 8-6. It will be noted that under Fifo unit costs are calculated only for the new cost inputs. Thus, the unit cost of \$1.66 represents the cost of a unit completed in Process 1 this period.

#### Alternate calculation of equivalent units

The calculation of equivalent units of production may be rationalized in an alternate way, giving the same results. The objective is to determine a measure of production activity which took place during the current period. A total of 25,000 units of product was completed and sent out of Process 1 during the period. However, one-half of the work on 10,000 of these units was accomplished in the prior month, leaving 20,000 as the equivalent number of units on which all processing was done in the current month. In addition to this 20,000 equivalent units which were both started and finished during the period, 80 percent of the work on the 5,000 units (4,000 equivalent units) of work in the end-

ing inventory was done during the period, making a total equivalent units of production of 24,000.

### Patterns of materials cost attachment

Referring to Exhibit 8-5, let us change the assumption that materials are added at the beginning of processing to illustrate the effect upon process costing of other patterns of materials cost attachment. Conversion costs will be ignored, since they would not be changed.

Materials data in Process 1 are as follows, in summary:

	Cost	Product units
Beginning inventory (one-half completed) . . . . .	\$ 3,600	10,000
Material added . . . . .	7,200	20,000
Total . . . . .	\$10,800	30,000
Semifinished X completed . . . . .		25,000
Ending inventory (four-fifths completed) . . . . .		5,000
Total . . . . .		30,000

Using these data, the materials costs assigned to the production completed and to the ending inventory will be illustrated for cases in which materials are added (1) continuously throughout processing, (2) at the end of processing, and (3) at the 30 percent stage of processing.

**Materials added continuously.** In this case materials cost is treated in the same manner as conversion costs, i.e., using equivalent units of production. In Exhibit 8-5 equivalent units of production are 24,000. Materials cost incurred during the period are \$7,200, or 30 cents per equivalent unit.

The assignment of materials cost is:

Semifinished X completed (25,000 units):

10,000 units, \$3,600 ÷ 5,000 (5,000 equivalent units × \$.30) . . . . .	\$5,100	
15,000 units × \$.30 . . . . .	4,500	\$ 9,600

Ending inventory (5,000 units, four-fifths completed):

4,000 equivalent units × \$.30 . . . . .	1,200	
	<u>\$10,800</u>	

**Materials added at end of processing.** In this case, only those products completed and transferred out of the process would be assigned materials costs. Examples of materials added according to this pattern are caps put on bottles after filling, packaging materials, and paint applied to the finished product.

In the illustration all of the period's materials cost of \$7,200 would be assigned to the 25,000 units completed at a cost rate of 28.8 cents. No cost would be attached to the ending inventory, because it is not yet completed.

Materials added at a stage in processing. Frequently, as in chemical manufacture and assembly processes, materials are added at a certain stage in processing. In the example, assuming the addition of materials at the 30 percent stage of processing, the \$7,200 materials cost would be assigned to the 5,000 units in the ending inventory and to only 15,000 of the 25,000 units completed and transferred. The other 10,000 units passed the 30 percent stage in a previous period. The cost per unit for the 20,000 units is 36 cents. Thus, \$5,400 ( $15,000 \times \$0.36$ ) would be assigned to the products completed and \$1,800 ( $5,000 \times \$0.36$ ) to the ending inventory.

### Process costs and the Lifo costing method

In illustrating the cost effects of the various patterns of adding materials to the production process, a first-in, first-out costing method was assumed. Other costing methods such as Lifo and average cost result in different costing of the production transferred and the ending inventory. Alternative costing methods are of importance when price levels for production inputs change.

The effect of the Lifo costing method for Process 1 of the Arbuckle Company is based upon the data for a particular period shown in Exhibit 8-7.

Assume that materials are added at the beginning of processing. Exhibit 8-7 also assumes that conversion costs attach continuously during processing. Notice that price levels for production inputs have increased substantially in comparison with the preceding period.

Since materials cost and conversion costs attach in a different pattern, each is discussed separately.

Materials cost. Under Lifo in contrast with Fifo, the beginning inventory costs are found in the ending inventory rather than in the cost of

*Exhibit 8-7*

### THE ARBUCKLE COMPANY Process Cost Account

#### Process 1

Beginning inventory (10,000 product units, one-half completed):		Accounted for as:	
Materials A and B	3,600	Semifinished X completed (15,000 product units)	
Conversion costs	7,800	Ending inventory (15,000 product units, one-half completed)	
Materials A and B (for 20,000 product units)	14,400		
Direct labor	32,000		
Direct overhead	6,300		
Indirect overhead	24,000		
	<u>88,100</u>		<u>88,100</u>

goods completed. The Lifo method thus costs the materials element of the ending inventory as follows:

15,000 product units, one-half completed:

10,000 beginning inventory units at materials cost of .....	\$3,600
5,000 units at cost level of current period of \$.72 ( $\$14,400 \div 20,000$ ) .....	3,600
	<u>\$7,200</u>

The materials cost of product units completed is:

15,000 product units at "latest" cost of 72 cents..... \$10,800

Total materials cost to account for is  $\$3,600 + \$14,400$ , or  $\$18,000$ . The ending inventory materials cost of  $\$7,200$  plus the materials cost of production completed of  $\$10,800$  equals  $\$18,000$ .

**Conversion costs.** The conversion costs in the beginning inventory under Lifo become a part of the ending inventory. Equivalent units of production amount to 17,500 (15,000 units started and completed plus 5,000 new units brought to the 50 percent stage of completion).

15,000 product units, one-half completed:

10,000 beginning inventory units at conversion cost .....	\$ 7,800
5,000 units (2,500 equivalent units) at cost level of current period of \$3.56 ( $\$62,300 \div 17,500$ ) .....	8,900
	<u>\$16,700</u>

The conversion cost attached to product units completed is:

15,000 product units at "latest" cost of \$3.56..... \$53,400

Total conversion costs to account for are  $\$7,800 + \$32,000$ ,  $\$6,300$ , and  $\$24,000$ , or  $\$70,100$ . The ending inventory conversion cost of  $\$16,700$  plus the conversion cost of production completed of  $\$53,400$  equals  $\$70,100$ .

In summary, under Lifo the costs are assigned as follows:

	<i>Ending inventory</i>	<i>Cost of product completed</i>
Materials cost .....	\$ 7,200	\$10,800
Conversion costs .....	16,700	53,400
Total .....	\$23,900	\$64,200
		23,900
Total costs accounted for .....		<u>\$88,100</u>

### The weighted-average method

Under the FIFO (or Lifo) costing methods, one must segregate the opening balance of work in process from the current cost inputs since the beginning work in process is the first batch of costs transferred out. When the weighted-average method is used, it is assumed that produc-



tion of the period applies equally to all costs regardless of whether they originated in the prior or current period. Under the average method, it is necessary to combine the materials costs in the opening inventory with current period materials costs; similarly, conversion costs and prior department costs in the opening work-in-process inventory must be combined with these current period costs.

A process cost report using the weighted-average method is illustrated in Exhibit 8-8, based on the data for the Arbuckle Company presented in Exhibit 8-7. The total combined materials cost was \$18,000, which resulted in production of 30,000 units, or a unit cost of 60 cents (materials added at beginning of process). The combined conversion cost was

*Exhibit 8-8*

**THE ARBUCKLE COMPANY**  
Process Cost Report

Process 1—Average Cost Method

	Total cost	Unit cost
Costs to be accounted for:		
Materials:		
In process.....	\$ 3,600	
New materials added.....	14,400	
Total materials costs.....	\$18,000	\$ .60
Conversion costs:		
In process.....	\$ 7,800	
Current period.....	62,300	
Total conversion costs.....	\$70,100	3.1156
Total costs to be accounted for.....	\$88,100	\$3.7156
Costs accounted for:		
Completed and transferred.....	\$55,734	
In process.....	32,366	
Total.....	\$88,100	
Units to be accounted for:		
In process.....	10,000	
New units added.....	20,000	
Total.....	30,000	
Units accounted for:		
Completed and transferred.....	15,000	
In process (one-half completed).....	15,000	
Total.....	30,000	
Equivalent units produced:		
Materials.....	30,000	
Conversion costs.....	22,500	

\$70,100, which resulted in equivalent production of 22,500 units ( $15,000 + \frac{1}{2} \times 15,000$ ), or \$3.1156 per unit. The total process costs are accounted for as follows:

Completed units: 15,000 @ \$3.7156.....	\$55,734
In process: 15,000 @ \$.60 + $\frac{1}{2}(15,000 \times \$3.1156)$ .....	32,366
Total costs accounted for.....	\$88,100

## Waste or spoilage

Waste, or spoilage, may be regarded as a secondary product which has no market value. Generally, there are two ways of dealing with the waste factor:

1. Production costs incurred during the period may be assigned to the waste, and it may be credited out of the process account as a loss directly to profit and loss or charged to Factory Overhead (debit: Loss from Waste; credit: Process Z, for example).

2. All production costs incurred during the period may be attached only to the "good" units produced. Under this method, the incurrence of waste increases the unit and total cost of the output which is produced.

These two methods of accounting for waste or spoilage are shown in Exhibit 8-9, which portrays Process Z of the Bishop Company. Ignoring beginning and ending work-in-process inventories, assume that in Process Z, 80,000 gallons of raw material costing \$16,000, result in an output of 60,000 gallons of product D. Conversion costs of \$14,000 are incurred during the month under consideration.

Under the first method described above, the \$30,000 costs would be accounted for in this manner:

Product D: 60,000 gal @ \$.375.....	\$22,500
Loss due to waste: 20,000 gal @ \$.375.....	7,500
Total costs accounted for.....	\$30,000

### Exhibit 8-9

#### THE BISHOP COMPANY Accounting for Waste or Spoilage

Process Z			
Beginning inventory	-0-	Product D produced:	
Material added: 80,000 gal		60,000 gal	
@ .20	16,000	Loss due to waste or spoilage:	
Conversion cost	14,000	20,000 gal	
		Ending inventory	-0-
Costs to account for	30,000	Costs accounted for	

The entry to record this in the accounts is:

Product D Inventory .....	22,500	
Loss Due to Waste .....	7,500	
Process Z .....		30,000

A variant of this first method, which results in a different *amount of loss*, is to recognize as a loss only the materials element. This may be especially appropriate when the spoilage occurs at an early stage in processing. In this situation, the following amounts would result:

Product D, 60,000 gal:	
Materials cost @ \$.20 .....	\$12,000
Conversion cost @ \$.23 .....	14,000
	<u>\$26,000</u>
Loss due to spoilage, 20,000 gal:	
Materials cost @ \$.20 .....	\$ 4,000
Total costs accounted for .....	<u>\$30,000</u>

Under the second method of dealing with the waste factor, all \$30,000 of the costs would be applied to product D (the "good" units) produced. The 60,000 gallons of output would have a total cost of \$30,000 (50 cents per gallon) and no loss, as such, would be recorded. The reader should notice that, under this method, the unit cost of product D is 50 cents per gallon, rather than 37.5 cents per gallon or  $43\frac{1}{3}$  cents per gallon under the two variations of the alternative method.

The first method of dealing with waste frequently is suggested when the waste or spoilage is abnormal in amount. Setting up a loss account brings the inefficient condition, represented by the factor of extraordinary waste, to the attention of managerial personnel. Such losses are not a normal cost which should be attached to products.

The second method of accounting for waste or spoilage usually is considered to be appropriate when the waste is unavoidable or normal in amount. Certain production techniques are of such a nature that some waste or spoilage is unavoidable and expected. There are weight losses, for example, in processes which require evaporation, or the burning, melting, or reduction of raw materials. In stamping product components out of sheets of metal, some waste of the metal often is unavoidable.

Defective units of product are a special type of waste. Accounting for these ordinarily depends upon their disposition. Some of the disposition possibilities are:

1. Sell as defective units (scrap)
2. Reprocess into good units
3. Discard as waste

If the defective units are sold as "irregulars," it may be appropriate to use the by-product method (to be discussed in the next chapter), or to regard revenue from the sale of the defective units as other income. When defective units are reprocessed, one method of accounting for

them is to attach materials cost only to them, reenter them in the process, and treat the defective units as any other materials coming into the process. In this case, any labor and overhead costs which have been incurred might be borne by the "good" products. Defective units which are discarded are considered to be waste or spoilage. In such a case, costs might be attached to them and treated as a loss (where defective production is abnormal in amount), or the unit and total cost of good units produced might be increased to reflect this waste (where defective units are normal, or expected).

### *The significance of unit cost data*

A knowledge of unit product costs is indispensable for purposes of inventory costing or income measurement. Unit cost data also may be useful in cost control and decision making. Some companies prepare reports on a regular basis, i.e., monthly, quarterly, etc., which compare the actual gross profit per unit with the standard gross profit. An example of this type of report appears in Exhibit 8-10. A report of this kind provides management with an integrated view of the composite effect of the various manufacturing activities on product cost. Such information may lead to pricing action or may focus attention on potential areas of cost reduction. This type of report is particularly useful when a company uses a full-cost approach in pricing its products, i.e., total factory cost plus an allowance for selling and administrative expenses and profit.

#### **Limitations to the use of unit cost data**

There are serious limitations to the use of unit product cost data, particularly in regard to cost control and decision making. For the purpose of income measurement, as long as the same costing procedures are employed from period to period, the data are comparable and conform to the accounting principle of consistency. The deficiencies of unit cost data, from the standpoint of cost control and decision making, are as follows:

1. Unit product costs are average costs. Generally, in decision making incremental or added costs are relevant, rather than average costs. Many companies, in order to provide such information, segregate their unit product costs according to fixed and variable elements, since the variable costs normally may be regarded as incremental.

2. Total unit product costs include both direct and indirect costs. Generally, from the standpoint of both cost control and decision making, allocated costs are not relevant. The allocation procedures rarely are sufficiently precise to produce meaningful data for these purposes. A product manager also normally has little control over allocated costs.

3. Factory overhead included in unit product costs often is based on the application of overhead by means of predetermined factory-overhead rates. These rates are based on a budgeted level of activity. However,

## Exhibit 8-10

**THE SMOOTHIE DOLL COMPANY**  
**Product Cost Statement**  
 Item      Panchita

	Standard	Actual	
		This quarter	Last quarter
Selling price.....	\$15.00	\$14.50	\$15.00
Manufacturing costs:			
Materials:			
Woodflour.....	\$ .10	\$ .101	\$ .102
Starch.....	.40	.386	.384
Resin.....	.20	.214	.215
Eyes.....	.65	.650	.650
Hair.....	.85	.892	.874
Dress.....	1.18	1.145	1.170
Box.....	.24	.241	.252
Miscellaneous.....	.38	.405	.416
Total.....	\$ 4.00	\$ 4.034	\$ 4.063
Direct labor:			
Mixing.....	\$ .17	\$ .196	\$ .203
Baking.....	.11	.115	.114
Patching and gluing.....	.40	.415	.419
Grinding and buffing.....	.29	.272	.270
Joining.....	.22	.248	.241
Painting.....	.46	.451	.451
Assembly and packing.....	.85	.839	.864
Total.....	\$ 2.50	\$ 2.536	\$ 2.562
Factory overhead:			
Mixing.....	\$ .34	\$ .363	\$ .371
Baking.....	.33	.338	.332
Patching and gluing.....	.60	.604	.611
Grinding and buffing.....	.58	.551	.546
Joining.....	.33	.332	.345
Painting.....	.69	.692	.691
Assembly and boxing.....	.63	.781	.742
Total.....	\$ 3.50	\$ 3.661	\$ 3.638
Total factory costs.....	\$10.00	\$10.231	\$10.263
Gross profit.....	\$ 5.00	\$ 4.269	\$ 4.737

dependent on the actual level of activity, unit costs may vary significantly. Many decisions are directly concerned with the extent of idle capacity. This may not be disclosed in product cost data, particularly when normal overhead rates are used.

4. The calculation of equivalent units of production in a process cost



manufacturing situation generally is based on judgment or is ignored. Frequently, ignoring the effect on unit costs of goods still in process may be entirely practical and have only a slight effect on the unit costs. This occurs when work in process tends to be approximately the same at the beginning and end of a period or when processing occurs rapidly, e.g., milk, chemicals, canned foods. In the latter case, the balance in work in process at any time tends to be relatively minor in comparison with cost of goods manufactured.

Failure to base unit costs on equivalent units produced, rather than actual number of units completed, can result in distortions in unit product cost data where work in process tends to be sizable in relation to the cost of goods manufactured. In such situations, the degree of completion of units in process at the end of a period may be estimated by qualified factory personnel. In a large and complex manufacturing operation, this is a difficult task, and the judgment of the estimator at times will result in errors in the unit cost data.

5. In the preceding discussion of process cost accounting, the manufacture of a single product was assumed. In most manufacturing situations, multiple products are produced. This means that somehow process costs must be allocated among products. Generally, this is done on the basis of more or less arbitrary allocations. The resultant product cost data may be satisfactory for purposes of income measurement as long as the particular allocation methods used are used consistently. However, such product cost data may be entirely useless for other management purposes. The problem of joint costs is discussed in the next chapter.

### *Process costs and internal profit measurement*

In the decentralized operations of a manufacturing firm, products may be transferred from one process, department, or organizational unit to another for further processing. Frequently, as in some integrated firms, the product has a market value at the end of each of a series of operations. In order that management may judge the performance of a given department (measure profit internally) in terms of the relationship of cost inputs and the market value of output of that department, transfers between departments may be made at market value rather than at cost.

To illustrate, assume that material A amounting to \$15,000 enters Process A in which \$30,000 of conversion costs are incurred. Ignoring beginning and ending in-process inventories, assume that the output of Process A could be sold for \$55,000. The value added, or internal profit generated by Process A, is \$10,000. If Process A is credited for \$55,000 and Process B is charged for that amount, the following management information has been developed:

1. The cost of Process A does not exceed income as indicated by the selling price figure.

**Exhibit 8-11****Internal Profit Measurement**

Process A		Process B	
Material	15,000	55,000	
Labor and factory overhead	30,000		
	55,000		

2. The performance of Process A is measured, i.e., a contribution to income and other firm expenses, costs, and losses of \$10,000.

3. Information is available for the decisions to make or buy, and sell or process further.

Information is provided to aid in planning future operations.

This example of internal profit measurement is shown in Exhibit 8-11. The credit balance in Process A represents value added by Process A. It should be noted that this technique will result in a finished goods inventory which is valued approximately at selling price. Stated another way, profit is recognized, under this method, as production takes place rather than at the point of sale. Since the recognition of income on a production basis is not normally acceptable for external reporting purposes, an adjustment such as the one shown below can be made at the time inventories are calculated and income is determined. In the adjustment it is assumed that none of the work in Process B has been done. This is the same as assuming that Process B is the Finished Goods Inventory account.

Allowance for Interdepartmental Profit (a contra account for Process A).....	10,000	
Process B (or Finished Goods).....		10,000

Where a market value for the output of Process A does not exist, the interdepartmental transfer price may be computed by adding a normal amount of selling expenses, general and administrative expenses, and net profit to the normal or standard cost of the output of Process A. For control purposes, this has the effect of pushing the profit objective and motivation of the firm down into lower operating levels. The various complexities encountered in the establishment of internal transfer prices will be explored at length in a subsequent chapter.

**Problems and cases**

- 8-1 *Industrial progress and process costing.* "The more industrially advanced a society is, the larger the proportion of its total manufacturing activities that are likely to conform to the process type of production." Comment.

- 8-2 *Time tickets and process costing.* Why may time tickets often be dispensed with under process costing? Under what circumstances may they be used?
- 8-3 *Types of process manufacturing.* Contrast sequential and parallel manufacturing. Of what significance is this distinction to the cost accountant?
- 8-4 *Conversion costs.* In determining the cost per unit under process costing, why is it possible to combine labor and overhead?
- 8-5 *Process costing—Fifo and average methods.* Under what set of circumstances will the unit product cost be identical under either Fifo or weighted-average methods?
- 8-6 *Calculating stage of completion of work in process.* Student to professor: "In all these process cost problems we are told what the degree of completion of the work-in-process inventories is. In actual practice, how do we determine the stage of completion? Is it always necessary to do so?"
- 8-7 *Cost treatment under job-order and process costing.* Indicate how the following costs might be handled differently under process and job-order costing: setup, overtime premium, and scrap.
- 8-8 *Fixed and variable unit costs.* What advantage is there in segregating unit product costs under process costing according to the fixed and variable cost elements?
- 8-9 *Flow of costs in process cost system; management cost report*  
 1. Trace the flow of actual costs, using amounts, through the sequential process cost accounts of the Kreps Company, assuming the data below. Materials A and B are added in Process 1, material C is added in Process 2, and material D is added in Process 3. The output of Process 3 is called Delma. Assume that there are no in-process inventories.

*Data for June:*

**Materials used:**

A .....	\$ 2,800
B .....	4,400
C .....	3,600
D .....	3,200

**Direct-labor cost incurred:**

Process 1 .....	\$16,000
Process 2 .....	12,000
Process 3 .....	24,000

**Factory overhead incurred:**

<b>Direct</b>	
Process 1 .....	\$ 3,200
Process 2 .....	4,000
Process 3 .....	8,000
<b>Indirect (allocated)</b>	
Process 1 .....	\$12,000
Process 2 .....	12,000
Process 3 .....	32,000

## PROCESS COST ACCOUNTING

2. On the assumption that there are no in-process inventories, what is the unit cost of the product after it leaves each process if 10,000 units were produced?
3. Prepare a management cost report indicating total and unit costs by process.

8-10 *Equivalent units: assignment of process costs to product*

1. Assuming no waste or spoilage, calculate the appropriate amounts for each question mark. Assume further that one unit of material is added at the beginning of processing for each finished-goods unit.

Finishing Process	
Jan. 1 inventory (Fifo), 1,000 units, $\frac{1}{2}$ finished:	Finished: (1) ? units..... (2) \$ ?
Materials.....	\$2,000
Labor and factory overhead...	4,000
	<u>\$6,000</u>
Costs this period:	Jan. 31 inventory (Fifo), 600 units, $\frac{1}{2}$ finished... (3) \$ ?
Materials, 9,000 units.....	\$ 9,000
Labor and factory overhead...	\$36,400

2. What is the unit cost of goods finished this month? What is the unit cost of finishing this month?

8-11 *Process costing-weighted-average method.* The following data represent the manufacturing activities of the Taylor Company for a particular month:

	Dept. 1	Dept. 2
In process, beginning of month:		
Materials from prior department.....	-0-	\$600
New materials added.....	\$4,000	200
Conversion costs.....	1,200	100
Total.....	<u>\$5,200</u>	<u>\$900</u>
Current month's costs:		
From prior department.....	-0-	?
New materials added.....	\$16,000	\$6,000
Conversion costs.....	4,120	3,000
Total.....	<u>\$20,120</u>	
Production data (units):		
In process, beginning of month.....	200	800
From prior department.....	-0-	3,700
New materials added.....	3,800	1,100
Total.....	<u>4,000</u>	<u>5,600</u>
Completed and transferred.....	3,700	4,800
In process, end of month.....	300	800
Total.....	<u>4,000</u>	<u>5,600</u>

All materials are added at the beginning of processing in each department. Units in process at the beginning of the period are one-half converted in both

departments. Units in process at the end of the month are one-third converted in both departments. The weighted-average costing method is used.

*Required:* Prepare a cost report.

- 8-12 *Process costing—Fifo, lost units.* The Singleton Company's cost and production data for a month are presented below:

	Dept. 1	Dept. 2	Dept. 3
<b>Cost data:</b>			
In process, beginning of the month.....	\$ 6,000	\$ 4,000	\$ 8,000
From prior department.....	-0-	?	?
New materials added.....	72,000	20,000	-0-
Conversion costs.....	36,300	30,000	20,000
<b>Total.....</b>	<b>\$114,300</b>		
<b>Production data:</b>			
In process, beginning of month.....	10,000	4,000	7,000
From prior department.....	-0-	120,000	160,000
New units added.....	120,000	40,000	-0-
<b>Total.....</b>	<b>130,000</b>	<b>164,000</b>	<b>167,000</b>
Completed and transferred.....	120,000	160,000	150,000
In process, end of month.....	10,000	4,000	10,000
Lost units.....	-0-	-0-	7,000
<b>Total.....</b>	<b>130,000</b>	<b>164,000</b>	<b>167,000</b>

All materials are added at the start of processing. Units in process in each department at the beginning of the month are 40 percent complete as to conversion costs and at the end of the month 50 percent complete. The company uses Fifo for costing inventories.

*Required:* Prepare a cost report.

- 8-13 *Process costs; equivalent units of production.* From the information submitted hereafter relative to a canceled production contract of Tad Co., Inc., prepare a statement of undelivered inventories at cost plus an allowance for general and administrative expenses applicable to the contract as at March 31, 1962, date of cancellation.

On November 18, 1961, Tad Co., Inc., contracted with a consumer to deliver 10,000 units of Meti to the latter as and when finished. By mutual consent this contract was canceled as of March 31, 1962, and the contracting parties have agreed to use a statement of undelivered inventories at cost plus an allowance for general and administrative expenses as at March 31, 1962, as a basis for negotiating settlement. There is also an understanding between Tad Co., Inc., and the supplier of raw materials used in Meti that any raw materials in excess of that applicable to the entire contract may be returned to the supplier, who will accept at cost on the basis of most recent purchases.

Meti is processed successively through Departments 20 and 30 and is the



sole product of these departments except for tools made and used in Department 20 for Meti.

Meti is made from two raw-material ingredients identified as O and P which are issued at the outset of processing in Department 20. Two units of O and one unit of P enter into one unit of Meti.

*Production data:*

1. No inventories were on hand at November 18, 1961, date of contract.
2. 1,500 units of Meti had been delivered to the customer under the contract as at December 31, 1961.
3. Applicable inventories as at January 1, 1962 follow:

a. Raw materials:

O, 2,000 units at \$3  
P, 1,000 units at \$1.80

b. Work in process:

Dept. 20, 800 units estimated to be 40% complete; cumulative cost, \$11,200  
Dept. 30, 600 units estimated to be 30% complete; cumulative cost, \$19,700

c. Finished goods, none

4. Raw materials purchased from January 1 to March 31, 1962, follow:

16,000 units of O at \$3.50 per unit  
5,100 units of P at \$2 per unit

Raw materials were issued on a first-in, first-out basis, as required.

5. Other costs and charges from January 1 to March 31, 1962, are:

	Dept. 20	Dept. 30
Direct labor.....	\$40,000	\$48,000
Direct departmental manufacturing overhead.....	50,000	60,200
General manufacturing overhead.....	5,600	6,720

6. Contract inventories at March 31, 1962:

Dept. 20, 500 units, 40% complete  
Dept. 30, 800 units, 70% complete

7. Work-in-process inventories as at March 31, 1962, are to be stated on the basis of current costs incurred from January 1 to March 31, 1962, without averaging therein beginning inventories as at January 1, 1962.
8. 5,700 units of Meti were delivered to the consumer under the contract from January 1 to March 31, 1962.
9. General manufacturing overhead from January 1 to March 31, 1962, totaling \$56,000, is prorated to departments in proportion to direct-labor cost. The total direct-labor cost for all departments, including Departments 20 and 30, is \$400,000.
10. Past experience shows that general and administrative expenses may be

applied at the rate of 15 percent of cost of sales. This percentage is deemed fair as an allowance on the cost of inventories.

11. An examination of the production data furnished discloses the following:
  - a. Direct labor, Department 20, includes \$3,000 of labor expended in making tools. Materials going into such tools, amounting to \$6,000, are included in direct manufacturing overhead. Direct manufacturing and general manufacturing overheads are applicable in proportion to direct labor. Forty percent of the tools manufactured have been completely used; the remaining tools have depreciated 60 percent but can be used on other lines of manufacture.
  - b. Direct labor, Department 20, other than that applied to tools, is overstated \$1,200 as a result of clerical errors in labor pricing totaling \$200 and of an incorrect classification of an indirect-labor item of \$1,000.
  - c. Direct manufacturing overhead, Department 30, includes a loss of \$800 on the sale of a machine used in that department. The company failed to accrue depreciation of \$200 from March 1 to March 22, the date of sale.
  - d. The records do not reflect a vendor's cancellation claim of \$300 (400 units of P at 75 cents) arising out of the contract cancellation. This claim is investigated and found to be proper.

(AICPA)

**8-14** *Process costs; unit production costs; interdepartmental transfers.* The Superior Hammer Company produces an expensive line of hammers. It operates its own handle department and a foundry department to produce the hammer heads. Assembly and finishing constitute a separate department.

In the foundry department, equal parts, by weight, of pig iron and coke, together with special alloy materials, are introduced into a furnace where the materials are reduced to molten metal which is poured into molds. The day's work in the foundry is as follows:

1. Remove and clean the heads cast on the previous day.
2. Set the molds for the current day's melt.
3. Load and "burn" the melt for the day.
4. Pour the metal into the molds.

One-fourth the labor cost is estimated to be applicable to step 1.

In the assembly and finishing department, the hammer heads are finished and the handles inserted. Handles are frequently spoiled in the process. Finished hammers are transferred to the stock room immediately.

On October 1, 1962, there was no inventory of any kind in the foundry department. During October, 20,000 heads were completed and transferred to the assembly and finishing department. At the end of the month 1,500 good, cleaned heads were on hand in the foundry, and 1,000 heads had been poured on the last day. A total of 22 tons of pig iron, coke, and alloy materials costing \$1,248 were placed in production. Direct-labor costs for the month amounted to \$4,380. Indirect costs were applied at 30 percent of direct-labor cost. A hammer head weighs 1 pound. An average of 10 percent of the heads poured are not perfect and are remelted.

On October 1 there were 400 hammer heads in the assembly and finishing department on which no work had been done. Their cost was \$128.24. There were no handles on hand. During October 20,000 handles costing \$9,876 were

received in this department. All the handles were used in completing 19,800 finished hammers. Labor cost amounted to \$1,834 and indirect costs to \$1,252.

*Required:* Prepare departmental cost and production reports showing unit production costs and the assignment of these costs to interdepartmental transfers or inventories for the month of October, 1962, for the foundry department and the assembly and finishing department. The company uses weighted-average cost in its accounts. Unit cost computations should be carried to five decimal places.

(AICPA)

8-15

*Process costs; equivalent units; determination of total and unit costs by elements; assignment of costs to work-in-process inventory.* The Walsch Company manufactures a single product, a mechanical device known as Klebo. The company maintains a process-cost type of accounting system.

The manufacturing operation is as follows: Material K, a metal, is stamped to form a part which is assembled with one of the purchased parts X. The unit is then machined and cleaned, after which it is assembled with two units of part Y to form the finished device known as a Klebo. Spray priming and enameling form the final operation.

Time and motion studies indicate that of the total time required for the manufacture of a unit the first operation required 25 percent of the labor cost, the first assembly an additional 25 percent, machining and cleaning 12.5 percent, the second assembly 25 percent, and painting 12.5 percent. Manufacturing expense is considered to follow the same pattern by operations as does labor.

The following data are presented to you as of October 31, the end of the first month of operation:

Material K purchased, 100,000 lb.....	\$25,000
Part X purchased, 80,000 units.....	16,000
Part Y purchased, 150,000 units.....	15,000
Primer and enamel used.....	1,072
Direct labor, cost.....	45,415
Manufacturing expenses.....	24,905
<i>Unit quantity</i>	
Units finished and sent to finished-goods warehouse.....	67,000
Units assembled but not painted.....	5,000
Units ready for the second assembly.....	3,000
<i>Inventories at the end of the month:</i>	
Finished units.....	7,500
Material K, lb.....	5,800
Part X (units of Part X).....	5,000
Part Y (units of Part Y).....	6,000
Klebos in process, units (3,000 + 5,000).....	8,000

*Required:*

1. A schedule of equivalent labor production
2. Total and unit costs incurred in production for:
  - a. Each kind of material
  - b. Labor cost

- c. Manufacturing expense
- d. Total cost of production
3. Detailed materials, labor, and manufacturing costs assigned to the units left in process

(AICPA)

8-16 *Royalty payments on lease.* The Deep Hole Mining Co. started mining in the current year on certain land leased from T. Realty Company.

The royalty provisions in the lease are as follows:

1. Minimum annual royalty, \$6,000, with minimum of \$1,500 payable quarterly. Unearned minimum royalties may be recovered in any subsequent period from earned royalties in excess of minimum royalties. Minimum royalties of \$18,000 were paid for the 3 years prior to the current year.
2. Earned royalty, 10 cents per ton shipped from the mine, plus a per ton amount equal to 2 percent of the amount by which the market value of the ore at the mine exceeds \$4 per ton.

Operations in the current year were as follows:

Periods	Tons shipped	Per ton	
		Market value at destination	Freight from mine to destination
1st quarter.....	None	-0-	-0-
2d quarter.....	100,000	\$10.50	\$3.10
3d quarter.....	200,000	10.00	3.20
4th quarter.....	None	-0-	-0-
	300,000		

*Required:* Compute the amount of royalty to be paid to T. Realty Company for the current year and the amount of unearned minimum royalty at the end of the year.

(AICPA)

8-17 *Process costs: management cost statements.* The Reese Extract Company produces flavoring extracts and spices for food products. The company has operated successfully for many years and carries an extensive line, with vanilla extract as its major product.

Vanilla extract is produced in two processes, percolating and mixing. In the percolating process, chopping of vanilla beans, percolating, and drying operations are carried out, while the mixing process has only the mixing operation. Inventories are carried in percolating tanks and in storage tanks both before and after the mixing process.

In the chopping operations, a sufficient number of beans are chopped for one batch of extract and placed in the percolator. Ten percolators are used, so that the production of the extract is continuous. The extract is piped from the percolator to storage tanks, while the residue is carried to a dryer. The



alcohol in the residue is recovered in the drying process and returned to storage. The dried residue is then discarded as waste.

Eleven hundred pounds of beans is chopped and sent to the percolator, where 405 gallons of alcohol and sufficient water to make the mixture total 1,000 gallons are added to make one batch of extract. Eight hundred gallons of extract, 45 percent alcohol, is produced in each batch, the remainder going to the dryer or being lost in the percolating process. Thirty-five gallons of alcohol is ordinarily recovered from the dryer for each batch.

The 45-percent-strength vanilla extract is then placed in storage tanks to await further processing. From these storage tanks, 400 gallons is drawn at a time and piped into a mixing tank, where it is mixed with a sugar-and-water solution. When mixing is complete, the alcohol content has been reduced to 36 percent.

The sugar-and-water solution is prepared by mixing 10 pounds of sugar with each gallon of water in the mixing tank. The contents of the mixing tank are then piped into storage tanks and, from there, to another location for packaging. For the purpose of this problem, the storage tanks containing the 36-percent-strength extract are to be considered the finished-goods stage.

Since labor is not a material item in the production of vanilla extract, wages are charged to burden. Manufacturing expenses are accumulated in two burden accounts, one for the percolating process and one for the mixing process. Storage and chopping costs are treated as a part of the burden costs of their respective processes. These costs are then allocated to production in each process.

Burden incurred for the period was as follows:

Percolating process.....	\$32,832
Mixing process.....	12,800

Alcohol costs 50 cents a gallon from the supplier, but a Federal tax of \$20.50 is levied on each gallon purchased. A rebate of \$19 a gallon of alcohol is allowed for all alcohol used in the production of extract. Usage is determined by applying the percentage strength to the quantity of extract piped to the packaging operations. Amounts of recoverable tax are excluded from these inventories and from manufacturing cost and are recorded in a separate account.

The first-in, first-out method is followed for inventories in the percolating process, but the weighted-average method is used for all other inventories, including those in storage tanks.

Periodic inventories have been taken, the results of which are as follows:

Jan. 1:		
In process, percolators, $\frac{1}{2}$ finished....	4 batches	\$6,370
Storage tanks, 45 % strength.....	3,200 gal	6,268
Mixing process.....	None	
Storage tanks, 36 % strength.....	2,000 gal	3,544
Dec. 31:		
In process, percolators, $\frac{1}{2}$ finished....	8 batches	
Storage tanks, 45 % strength.....	4,000 gal	
Mixing process.....	None	
Storage tanks, 36 % strength.....	2,500 gal	



During the year of operations, 130 batches were started in the percolators; 100,000 gallons of 45 percent-strength extract was piped into the mixing process, and 250,000 pounds of sugar was added to the solution. Average cost of vanilla beans was 50 cents a pound, while sugar cost 5 cents a pound.

You are to prepare:

1. Manufacturing statement showing costs, units, and prices by processes
2. Computations showing the rebate to be claimed from the Federal government for the period and the amount of deferrable tax applicable to the inventories which have not gone to the packaging department

(AICPA)

**8-18** *Process costs; spoilage; equivalent units; costing of work-in-process inventories and transfers between processes.* The King Process Company manufactures one product, processing it through two processes, Nos. 1 and 2.

For each unit of Process 1 output, two units of raw material X are put in at the start of processing. For each unit of Process 2 output, three cans of raw material Y are put in at the end of processing. Two pounds of Process 1 output is placed in at the start of Process 2 for each unit of finished goods started.

Spoilage generally occurs in Process 2 when processing is approximately 50 percent complete.

In-process accounts are maintained for raw materials, conversion costs, and prior department costs.

The company uses the FIFO basis for inventory valuation for Process 1 and finished goods and the average cost for inventory valuation for Process 2.

*Data for March:*

1. Units transferred:

From Process 1 to Process 2, 2,200 lb

From Process 2 to Finished Goods, 900 gal

From Finished Goods to Cost of Goods Sold, 600 gal

2. Units spoiled in Process 2, 100 gal
3. Raw-materials unit costs: X, \$1.51 per unit; Y, \$2 per can
4. Conversion costs: Process 1, \$3,344; Process 2, \$4,010
5. Spoilage recovery: \$100 (treated as cost reduction)
6. Inventory data:

	Process 1		Process 2		Finished goods	
	Initial	Final	Initial	Final	Initial	Final
Units	200	300	200	300	700	1,000
Fraction complete:						
Conversion costs	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{2}$	$\frac{2}{3}$		
Valuation					\$13,300	
Materials	\$560		-0-			
Conversion costs	\$108		\$390			
Prior department costs			\$2,200			

*Required:* Journalize March entries to record the transfer of costs from Process 1 to Process 2, from Process 2 to Finished Goods, and from Finished Goods to Cost of Goods Sold.

(AICPA)

8-19

*Process costs; defective units; equivalent units; costing of work-in-process inventories and goods completed.* As a management consultant, you are examining the dollar investment in inventories of the ABC Manufacturing Company. The inventories on the company's financial statements as of December 31 are as follows:

Finished-goods inventory, 110,000 units .....	\$504,900
Work-in-process inventory, 90,000 units, 50% completed .....	330,480

The company follows the practice of pricing the above inventories at the lower of cost or market on a first-in, first-out method. You learn that materials are added to the production line at the start of the process and that overhead is applied to the product at the rate of 75 percent based on direct-labor dollars. You also learn that the market value of the Finished Goods Inventory and the Work in Process Inventory is greater than the amounts shown above, with the exception of the defective units in the ending inventory of finished goods, the market value of which amounts to \$1 per unit.

A review of the company's cost records shows the following information:

	Amounts		
	Units	Materials	Labor
Beginning inventory, Jan. 1, 80% completed .....	100,000	\$100,000	\$160,000
Additional units started during year .....	500,000	350,000	997,500
Materials costs incurred .....			
Labor costs incurred .....			
Units completed during year:			
Good units .....	500,000		
Defective units .....	10,000		
Finished-goods inventory at Dec. 31, includes 10,000 defective units .....			

You also learn that the defective units occur at the end of the process; i.e., units are found to be defective at the point of final inspection.

*Required:*

- Exhibits indicating:
  - Effective or equivalent production
  - Unit costs of production of materials, labor, and overhead
  - Pricing of inventories of finished goods, defective units, and work in process
- The necessary journal entry or entries, if any, to state correctly inventory valuation of finished goods and work in process (ignore income tax considerations)

**8-20** *Process costs: equivalent production, lost units.* The Biltmar Company manufactures gewgaws in three steps or departments. The finishing department is the third and last step before the product is transferred to finished goods inventory.

All material needed to complete the gewgaws is added at the beginning of the process in the finishing department, and lost units, if any, occur only at this point. The company uses the FIFO cost method in its accounting system and has accumulated the following data for July for the finishing department:

1. Production of gewgaws:

In process, July 1 (labor and manufacturing expense three-fourths complete).....	10,000 units
Transferred from preceding departments during July.....	40,000 units
Finished and transferred to finished goods inventory during July.....	35,000 units
In process, July 31 (labor and manufacturing expense one-half complete).....	10,000 units

2. Cost of work in process inventory, July 1:

Cost from preceding departments.....	\$ 38,000
Costs added in finishing department prior to July 1:	
Materials.....	21,500
Labor.....	39,000
Manufacturing expense.....	42,000
Cost of work in process inventory, July 1.....	<u>\$140,500</u>

3. Gewgaws transferred to the finishing department during July had costs of \$140,000 assigned from preceding departments.

4. During July, the finishing department incurred the following production costs:

Material.....	\$ 70,000
Labor.....	162,500
Manufacturing expense.....	130,000
Total.....	<u>\$362,500</u>

*Required:*

1. The cost of the gewgaws lost in production during July
2. The cost of the gewgaws transferred to finished goods inventory in July
3. The cost of the work in process inventory at July 31

(AICPA)

**8-21** *Process costs: cost of lost units.* The Incredible Gadget Corp. manufactures a single product. Its operations are a continuing process carried on in two departments—the machining department and the assembly and finishing department. Materials are added to the product in each department without increasing the number of units produced.

In the month of May, 1963, the records showed that 75,000 units were put in production in the machining department. Of these units, 60,000 were completed and transferred to assembly and finishing, and 15,000 were left in process with all materials applied but with only one-third of the required labor and overhead.

In the assembly and finishing department 50,000 units were completed and transferred to the finished stock room during the month. Nine thousand units were in process on May 31, 1,000 units having been destroyed in production with no scrap value. All required materials had been applied to the 9,000 units and two-thirds of the labor and overhead, but only one-half of the prescribed material and labor had been applied to the 1,000 units lost in process.

There was no work in process in either department at the first of the month.

*The cost of units lost in production should be treated as additional overhead in the assembly and finishing department.*

Cost records showed the following charges during the month:

	Materials	Labor	Overhead
Machining department.....	\$120,000	\$ 87,100	\$39,000
Assembly and finishing department.....	41,650	101,700	56,810*

\* Does not include the cost of spoiled units.

1. Prepare in good form a statement showing the unit cost for the month.
2. Prepare a schedule showing the details of the work in process inventory in each department.

(AICPA)

## 9. Joint- and By-product Costs

In previous chapters, the calculation of product costs assumed that materials and direct labor could be identified directly with finished products and that factory-overhead costs could be assigned to products on a basis believed to be representative of the manner in which overhead costs actually flowed into products. This chapter will deal with situations in which two or more products are manufactured jointly out of a single batch of cost inputs which cannot be readily identified with, or traced to, individual products. In such cases, some method must be employed to allocate total costs among the joint products. Otherwise, unit product costs cannot be developed or period income measured.

### Distinction between joint products and by-products

When two or more products emerge from a single raw material or process or from several raw materials and processes, the output is referred to as either *joint products* (sometimes also called *co-products*) or *major product* and *by-product*. The determination of whether two products resulting from the same cost inputs are to be classified as joint products or one as major product and the other as by-product depends primarily upon management objectives and policies. Definitive criteria for distinguishing between these two classes of products do not exist.

Generally, the differentiation between a joint product and a by-product tends to be based on the relative sales of the product. Using this criterion, if revenues from each of two products are somewhat equal in amount or at least significant in relation to total revenue, they are treated as joint products. If on the other hand, revenues from one product are relatively minor in importance, the product would be classified as a by-product. In terms of the relative sales criterion, it is entirely possible for a by-product at one point in time to become a joint product at another point in time, and vice versa.

Other criteria used in making the distinction between joint products and by-products include expressed business objectives, profit pattern desired, the need for further processing prior to sale, and certainty of markets. A relatively important product, for example, with an uncertain



market might be classified as a by-product rather than a joint product. The distinction between joint products and by-products is not academic, since it determines whether the *joint-product method of cost accounting* or the *by-product method of cost accounting* is used and it has an important effect on income.

### The nature of manufacturing activity and product classification

Manufacturing activities generally may be classified (1) as synthesizing or fabricating activities or (2) as analytic-type activities. Building construction, furniture manufacturing, equipment manufacturing, and other types of activities in which raw materials and component parts are assembled together to synthesize, or *build up*, the end product are examples of the first type of activity.

In the analytic type of manufacturing, raw materials are analyzed, or *broken-down*, into several major products. In meat packing, the carcass of an animal (raw material) produces different cuts of meats, leather, fertilizer, etc. Petroleum refining converts crude oil into a variety of finished products including gasoline, lubricating oil, fuel oil, diesel oil, kerosene, and naphtha. In a lumber mill, a given shipment of timber may yield different grades of lumber.

The more complex joint cost situations are found in analytic manufacturing. However, aspects of joint costs occur even in assembly industries. Many factory-overhead items have an indirect relationship to processes and products; i.e., two or more products may be served jointly by a single facility or other overhead cost. The similarity between indirect factory-overhead costs and joint-product costs is shown in Fig. 9-1. However, an important difference should be noted: the basis selected for allocating overhead costs is presumed to reflect the manner in which overhead actually flows into processes or products. In other words, the presumption exists that overhead costs are traceable to, or can be identified with, specific processes or products. In a joint-product situa-

Indirect factory overhead (indirect with respect to products or departments):



Costs common to joint products:

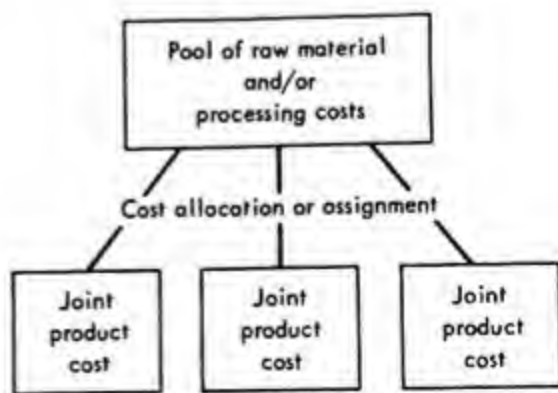


Fig. 9-1 Indirect factory overhead (indirect with respect to products or departments); costs common to joint products.

tion, this presumption generally is unwarranted, and the basis for allocating total costs to products becomes largely arbitrary.

### *Accounting for joint products*

The objective of joint-product cost accounting is to assign a portion of the total joint costs to each joint product, so that unit product costs may be calculated and income statement and balance sheet prepared. This is illustrated in Fig. 9-2. The problem essentially is one of cost allocation. In practice a variety of methods are employed, among which the following are perhaps most common:

**Relative sales value of production.** According to this method, the number of units of each product manufactured is multiplied by the product's selling price, to obtain the sales value of production. The portion of total joint costs allocated to each product is equal to the ratio of the sales value of each product's output to the sales value of all production. Exhibit 9-1 shows how this method is used by a tobacco company. The total purchases of ungraded tobacco leaves by this company amounted to 20 million pounds at a cost of \$6.8 million. When sorted this produced three grades of tobacco with market values as indicated. The market value of the sorted production is used to assign the total cost of the unsorted tobacco to the three grades produced, resulting in unit costs shown in the final column of Exhibit 9-1.

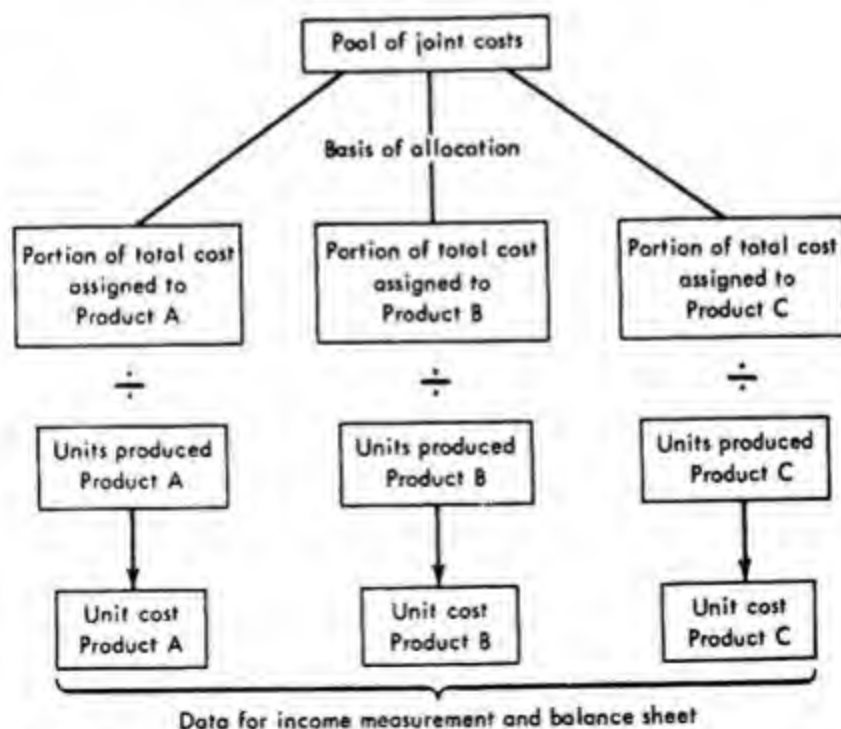


Fig. 9-2 Joint-product cost flow.

## Exhibit 9-1

**ROBERTSON TOBACCO COMPANY**  
 Relative Sales Value Method for Allocating Joint Costs

<i>Tobacco-leaf grades</i>	<i>Sorted quantities produced (in M of lb)</i>	<i>Unit sales price (per lb)</i>	<i>Market value of sorted production (in M of dollars)</i>	<i>Percent of total</i>	<i>Allocated total cost (in M of dollars)</i>	<i>Unit cost (per M lb)</i>
1	14,000	\$ .55	\$7,700	82.4	\$5,603.2	\$400.2
2	4,000	.30	1,200	12.9	877.2	219.3
3	2,000	.22	440	4.7	319.6	159.8
Total.....	20,000		\$9,340	100.0	\$6,800.0	

The use of this method for allocating joint costs presumes that a relationship exists between price and cost. This does not imply that product costs are the basis for setting prices. On the contrary, prices of joint products tend to be based on interindustry competition, supplies on hand, world market conditions, and other considerations.

Under this method, products or product lines are charged with "what they will bear." This produces an equality of product profit margins, i.e., gross return on sales. For example in Exhibit 9-2, the cost per unit of each product is 67 percent of its net contribution at the split-off point. Despite this limitation, the method is commonly used and under most circumstances is justifiable. Since joint costs cannot be identified with joint products in any real sense, some cost flow must be imputed. In the absence of other information it is not unreasonable to assume that high-price products are also high-cost items, and vice versa.

## Exhibit 9-2

 Relative Sales Value Method for Allocating Joint Costs  
 (Additional Processing after Split-off Point)

<i>Product</i>	<i>Selling price</i>	<i>Processing costs per unit after split-off</i>	<i>Net contribution per unit at split-off point</i>	<i>Units produced</i>	<i>Total contribution at split-off point</i>	<i>Product contribution, %</i>	<i>Allocation of joint costs</i>	<i>Product unit cost</i>
A	\$4.00	\$1.00	\$3.00	10,000	\$30,000	66.7	\$20,000	\$2.00
B	2.50	—0—	2.50	6,000	15,000	33.3	10,000	1.67
Total....				16,000	\$45,000	100.0	\$30,000	

A variation of the relative market value of production method (assumed in Exhibit 9-2) is used when one or more products requires additional processing, after emerging from the joint cost split-off point. These separately identifiable processing costs are subtracted from the selling prices. The resultant net product contribution at the split-off point is then applied to production to provide the basis for allocating joint costs. In Exhibit 9-2, the total joint cost at the split-off point amounts to \$30,000. Product B is sold without additional processing at \$2.50 per unit. However, the 10,000 units of product A require further processing, amounting to \$10,000, before being sold at \$4.00 per unit.

**Physical measurements of output.** Under this method, joint costs are allocated to joint products on the basis of physical units of output, i.e., pounds, tons, gallons, etc. This method generally cannot be employed when output consists of different types of units, e.g., liquids and solids, unless they can be equated. The use of output units for allocating joint costs is rarely justified. Generally it is illogical to assume that physical units have equal value. A pound of sirloin steak has greater value than a pound of chuck steak. A gallon of lubricating oil is worth substantially more than a gallon of gasoline. If a parcel of land is purchased and then subdivided into lots, with varying sales values because of terrain or location differences, it is reasonable to assume that the acquisition price of the land took into consideration these divergent values. An illustration of the use of this method as applied in the manufacture of coke appears in Exhibit 9-3. The cost per ton of coal (\$8) is allocated to products on the basis of pounds produced.

**Average unit cost method.** According to this method, no effort is made to calculate separate costs for each of the joint products. Instead, an average cost is calculated for all products which is used for inventory-costing purposes. In effect, the underlying premise is that since joint costs cannot really be identified with specific products, average unit costs are as satisfactory as any other basis for income measurement, providing

### Exhibit 9-3

#### WILLIAMSON COKE MANUFACTURING COMPANY Physical Unit Basis for Allocating Joint Costs

<i>Product</i>	<i>Product weight, lb</i>	<i>Percent of total</i>	<i>Allocated product cost</i>
Coke.....	1,300	68.4	\$5.47
Coal tar.....	150	7.9	.63
Gas.....	350	18.4	1.47
Other products.....	100	5.3	.43
Waste.....	100	-0-	-0-
Total.....	2,000	100.0	\$8.00

## Exhibit 9-4

**HARRISON OIL COMPANY, INC.**  
**Standard-yield Method for Allocating Joint Costs**

	Standard yield, per 100 gal (1)	Market value, per gal (2)	Realiza- ble revenues, (1) × (2) (3)	Total realizable revenues, % (4)	Allocated cost, per 100 gal (5)	Cost per gal (5) ÷ (1) (6)
Gasoline.....	32.0	\$ .14	\$4.48	53.8	\$3.658	\$.114
Lubricating oil....	5.0	.18	.90	10.8	.734	.147
Fuel oil.....	50.0	.04	2.00	24.0	1.632	.033
Benzine, kerosene..	8.0	.10	.80	9.6	.653	.081
Gas oil.....	3.0	.05	.15	1.8	.123	.041
Loss.....	2.0	-0-	-0-	-0-	-0-	-0-
<b>Total.....</b>	<b>100.0</b>		<b>\$8.33</b>	<b>100.0</b>	<b>\$6.80</b>	

they are used consistently. An example of the use of this method in a lumber mill is shown below:

Total board feet of production.....	6,000,000
Total joint costs.....	\$150,000,000
Cost per thousand board feet.....	\$25

**Standard-yield method.** In this method, raw-material and process costs are allocated to joint products on the basis of standard yields. Exhibit 9-4 shows how the method is used in an oil refinery in which cost of crude oil and processing amounts to \$6.80 per 100 gallons.

### Illustration of the effect of joint-product cost methods on income determination

The Deeth Company processes raw material A, in an operation called the separation process, into two basic products, X and Y, which are then further processed or sold. In Exhibit 9-5 the following facts about the operations of the Deeth Company are assumed:

1. Within the separation process, the joint-product cost accounting method is used.

2. Material A is added at the beginning stage of processing, and the separation of the two products X and Y occurs virtually at the end of processing.

3. Conversion costs attach to production uniformly throughout processing.

4. The inventory of work in process is constant; i.e., the ending inventory level is the same as the beginning inventory level. The Lifo method of costing inventory is used.



## Exhibit 9-5

**THE DEETH COMPANY**  
Separation Process

Beginning inventory—2,000 lb, one-fourth finished:		Product X completed: 10,000 lb	
Material cost	2,400	Product Y completed: 20,000 lb	
Conversion cost	400	Ending inventory: 2,000 lb, one-fourth finished	
Material A added: 30,000 lb		Material cost	2,400
@ 1.20	36,000	Conversion cost	400
Conversion costs	24,000		
Costs to account for	<u>62,800</u>	Costs accounted for	<u>      </u>

In Exhibit 9-5 production data for the month of June are as follows:

Work-in-process inventory:

Beginning—2,000 lb, one-fourth finished:	
Material cost.....	\$2,400
Conversion cost.....	\$400
Ending—2,000 lb, one-fourth finished:	
Material cost.....	\$2,400
Conversion cost.....	\$400
Material A put into the separation process during the month: 30,000 lb @ \$1.20.....	\$36,000
Conversion costs incurred during the month of June in the separation process.....	\$24,000
Basic product X completed (sales price: \$4 per lb)....	10,000 lb
Basic product Y completed (sales price: \$2 per lb)....	20,000 lb

No waste, shrinkage, expansion, or scrap is assumed. Under Lifo, in this case, the beginning and ending inventories are costed at the same amounts.

Exhibit 9-5 presents this information as it appears in the Separation Process account.

Since the opening and closing work-in-process inventory remains unchanged, the problem is to assign current material and conversion costs totaling \$60,000 (Exhibit 9-5) to the two products, X and Y, using the joint-product method. Three methods of allocation will be considered.

Method 1: Relative *weight* of output

Method 2: Relative *sales value* of output

Method 3: Relative *selling price* per unit of products

Product costs obtained under each of these methods are shown below:

**Method 1:**

Product X:  $10,000 \div 30,000 \times \$60,000 = \$20,000$ , or \$2 per lb

Product Y:  $20,000 \div 30,000 \times \$60,000 = \$40,000$ , or \$2 per lb

**Method 2:**

Product X:  $\$40,000 \div \$80,000 \times \$60,000 = \$30,000$ , or \$3 per lb  
 Product Y:  $\$40,000 \div \$80,000 \times \$60,000 = \$30,000$ , or \$1.50 per lb

**Method 3:**

Product X:  $\$4 \div \$6 \times \$60,000 = \$40,000$ , or \$4 per unit  
 Product Y:  $\$2 \div \$6 \times \$60,000 = \$20,000$ , or \$1 per unit

The effect on the income of the Deeth Company is shown in Exhibit 9-6. It is apparent that the selection of a particular method for allocating joint costs to products can have a significant impact on reported product income or profit contribution. Inasmuch as inventories also are costed at different costs, dependent on which allocation method is used, reported company income also is affected. In this connection, it should be emphasized that whichever method is adopted, it should be used consistently. This of course permits comparison of a company's present income with that of prior periods. However, the use of diverse allocation methods is one factor that tends to make income comparisons for different companies, even in the same industry, difficult.

**Exhibit 9-6**

**THE DEETH COMPANY**  
 Profit Contribution under Alternate Joint-product Costing Methods

	Method 1		Method 2		Method 3	
	X	Y	X	Y	X	Y
Revenue.....	\$40,000	\$40,000	\$40,000	\$40,000	\$40,000	\$40,000
Production cost.....	20,000	40,000	30,000	30,000	40,000	20,000
Profit contribution...	\$20,000	-0-	\$10,000	\$10,000	-0-	\$20,000

**Joint costs and management decisions**

Thus far in the joint cost discussion, the costing techniques have been geared to product costing and income measurement. It is apparent that the allocation of costs to joint products is largely arbitrary. While joint cost accounting is essential for income measurement, the product costs derived have little value to management for decision making. Stated more emphatically, the use of joint-product costs in management decisions often will result in erroneous decisions.

This can be illustrated by assuming that two products, X and Y, have unit costs of \$12 each, calculated as shown on page 60. The present market price for X is \$15 and for Y, \$11.

<i>Product</i>	<i>Production, units</i>	<i>Allocated joint costs</i>	<i>Unit cost</i>
X	10,000	\$120,000	\$12
Y	5,000	60,000	12

If all units produced were sold, the following income statement might be prepared:

	<i>Product X</i>	<i>Product Y</i>	<i>Combined</i>
Revenues.....	\$150,000	\$55,000	\$205,000
Costs .....	120,000	60,000	180,000
Income.....	\$ 30,000	(\$ 5,000)	\$ 25,000

It would seem that since product Y shows a loss, the company would be better off by not selling product Y. This is of course a mirage. Since these are joint products, product X cannot be produced without product Y. If the 5,000 units of product Y were not sold, all of the \$180,000 of costs would apply to product X, and a combined loss of \$30,000 would be sustained instead of a combined profit of \$25,000. The difference of \$55,000 represents product Y's revenue contribution.

Let us now assume that a portion of product Y's production, which cannot be sold externally, is being shipped to another division within the company, and being billed at the unit cost of \$12. The manager of the receiving division contends that since he can obtain the same product on the market at \$11 per unit, both his division and the company are sustaining a loss of \$1 on every unit he procures internally. He is only partly correct. Since these units cannot be sold externally, there is an actual gain to the company of \$11 per unit, when these items are used internally. However, from the standpoint of performance evaluation, it is undeniable that the receiving division has been penalized, and an adjustment in the intracompany transfer price is warranted.

Let us now suppose that product Y can be converted into product Z by further processing which will amount to \$2 a unit. Product Z can be sold for \$13.50 per unit. If this were done, product Z would have a cost of \$14 (product Y cost of \$12 + \$2 additional processing) to be matched against a price of \$13.50, resulting in a loss of 50 cents per unit. This might seem to suggest that additional processing is not warranted. This is incorrect. Only *added* revenues and costs are relevant in a decision of this type. Accordingly, product Z should be produced, since the added revenues (\$2.50) exceed the added cost (\$2).

In decisions such as this, other noncost considerations must be recognized. A firm, for example, may wish to sell rather than to process further because of difficulties in obtaining materials or labor to do the further processing or because of a desire not to expand its efforts in this direction. Conversely, the firm may decide to process further regardless of the cost considerations in order to maintain a stable working force.

Further processing may be appropriate in anticipation of expanding the production of Z in case product X should be losing importance.

In the example, we considered only *additional, direct* processing costs, which is logical. In spite of this, many businessmen and accountants will insist that product Z should bear "its fair share" of indirect costs associated with the production of X and Y. Assigning some of these costs to the processing of Z, if that alternative is chosen, may be appropriate for product profitability calculations after the alternative is chosen, although even this is doubtful under most circumstances. Such costs, however, are not appropriate to include in the analysis for making the decision to sell or process further.

It was suggested earlier in this discussion that the unit cost derived for a joint product ordinarily should not be used as the basis for setting selling prices. In a joint cost situation, it is only total revenues and costs that have relevance, rather than individual product revenues and costs. In this connection, it often is possible to alter the product mix of joint products, e.g., in oil refining. Where this is the case, major emphasis is placed on obtaining the product mix which results in a maximization of incremental income.

### *The by-product costing method*

The by-product method of costing products assumes that at least one of the products which constitute the firm's output is of secondary importance in terms of relative sales revenue or other criteria used. If the revenue provided by the secondary product is rather minor, the product is referred to as scrap or salvage. Other tangible items which come into existence in the production process but which have no sales value whatsoever are known as waste or spoilage.

The by-product method of accounting assumes that the secondary product has a market value. Therefore, in this discussion, the method applies when the secondary product's market value is fairly important but not as important as the sales value of the output of the major product or products (by-product), and also when the sales value of the secondary product is relatively minor (scrap or salvage). The term *secondary product* in this discussion includes both by-products and scrap. The various methods of dealing with the secondary product have an effect upon the total and unit costs of the main products.

Under the by-product method of accounting, the estimated market or sales value of the secondary product is deducted from the total production cost incurred in producing all products, main and secondary. This residual amount is then allocated to the one or more main products, using the joint cost method if joint products exist. The secondary product is carried in inventory at its estimated market value.

Exhibit 9-7 depicts the by-product method of accounting utilized by the Rasmus Company for two main products, A and B, and one sec-



## Exhibit 9-7

THE RASMUS COMPANY  
Joint-product Costing

Process X

Beginning inventory	-0-	Main product A: 2,500 units	10,000
Processing costs: raw materials,		Main product B: 2,000 units	8,000
direct labor, and factory		By-product C (by-product or	
overhead (10,000 lb		scrap): 1,000 lb	300
material)	18,300	Ending inventory	-0-
Costs to account for	<u>18,300</u>	Costs accounted for	<u>18,300</u>

ondary product, C, resulting from Process X. The estimated market value of product C produced during the period amounts to \$300. For simplicity, no beginning and ending inventories are assumed.

The entry to reduce the production costs assignable to the main products by the amount of the estimated market value of the output of the by-product is:

By-product C (or Scrap) Inventory (at estimated market value).....	300
Process X.....	300

The remaining costs of \$18,000 (\$18,300 — \$300) are assigned to products A and B. On a quantity basis, under the joint-product method, the allocation amounts to:

Product A:  $2,500 \div 4,500 \times \$18,000$ , or \$10,000

Product B:  $2,000 \div 4,500 \times \$18,000$ , or \$8,000

The entry to record the transfer of completed units to finished goods is:

Product A Inventory (at cost).....	10,000
Product B Inventory (at cost).....	8,000
Process X.....	18,000

Under the by-product method, the sales value of by-product output actually is entered in the accounts as the inventory of the by-product and as a reduction in production costs assignable to the main products. In the joint cost method, on the other hand, the *relative* sales value of the output of products may be used merely as a *basis* for the allocation of production *costs* to joint products. That is, under the joint cost method of costing, sales values themselves are *not* entered in the accounts as they are under the by-product method.

A variant of the by-product method discussed above is the valuation of the by-product or scrap at its estimated selling price minus (1) estimated costs of disposing of the by-product or scrap and/or (2) an estimated amount of normal profit.

For example, assume that it is estimated that disposition costs of \$45



would be incurred in selling the by-product or scrap whose estimated market value is \$300. The net amount of \$255 is then deducted from \$18,300, leaving \$18,045 to be allocated to products A and B. Assuming that the joint cost method is used, on the basis of relative units of A and B, the entry to account for Process X costs is:

By-product C (or Scrap) Inventory	255	
Product A Inventory	10,025	
Product B Inventory	8,020	
Process X		18,300

Assuming that by-product C output is sold for \$300 and that selling expenses actually amount to \$45, no profit is shown for the sale of by-product C. Instead, the net proceeds of \$255 have been used, in effect, to reduce the total cost of products A and B to \$18,045 and thus to increase their profitability.

If, in addition, a normal profit of 5 percent of gross selling price also is to be deducted from the market value of product C, the calculations and entry would be as follows:

By-product C (or Scrap) Inventory	240	
Product A Inventory	10,033	
Product B Inventory	8,027	
Process X		18,300

Assuming that product C is sold for \$300 and that disposition costs amount to \$45, the profit attributed to product C would be \$15, which was the 5 percent normal profit figure used in the valuation of by-product C inventory. Attributing this normal profit to by-product C in this manner has the effect of reducing the total cost of products A and B to \$18,060, rather than to \$18,045 as in the previous case above. Thus, the \$15 profit shown for by-product C would otherwise have been shown for products A and B, through lower product costs of the main products.

An alternative to the by-product method of handling secondary products is that of considering the revenue from secondary product sales to be miscellaneous or other income. Under such a procedure, the total production costs of \$18,300 are assigned only to products A and B. (On a joint cost basis, using relative units of product, product A would be costed at \$10,167 and product B at \$8,133.) In this case, no monetary figure is attached to by-product C inventory. If an inventory is taken prior to sale, the by-product is inventoried in memorandum form showing quantities only. Entries to account for this situation would be:

Product A Inventory	10,167	
Product B Inventory	8,133	
Process X		18,300

At the time of the sale of by-product C, the entries would be:

Cash or Receivables	300	
Income from Sale of By-product C (or Scrap)		300
Selling Expenses	45	
Cash or Payables		45

When this method is used, the method of accounting for by-product C in no way affects the product cost of product A or product B.

There are no established rules governing which method should be used in a particular case. The importance of the by-products and the desire to show a profit or not to show a profit from by-product sales are factors considered in deciding how to account for by-products.

## *Problems and cases*

- 9-1 *Joint costs and management decisions.* "We must allocate total costs to joint products. How else can management make intelligent decisions?" Comment.
- 9-2 *Joint costs and income measurement.* "Regardless of the arbitrary nature of joint-cost allocations, this procedure is essential for income measurement. The redeeming feature of accounting measurement of income is consistency." Comment.
- 9-3 *Joint-product costing and overhead costing.* What similarities exist between joint costing and overhead costing? What is the essential difference?
- 9-4 *Joint cost allocation methods.* List and briefly describe three methods for allocating total factory costs to joint products.
- 9-5 *Joint costs and pricing decisions.* After allocating total costs to joint products, the inventory cost of product X is \$8. The company receives an offer for the purchase of a large quantity of product X at \$7.90. Should it accept the offer? What if the price were \$8.50? Would it be helpful in making this type of decision if, in allocating joint costs, the final product costs were separated into fixed and variable elements?
- 9-6 *Methods of accounting for by-products.* List and describe two methods of accounting for by-products.
- 9-7 *Joint costs and decision making.* Controller to president (oil company): "Because of the arbitrary nature of our joint cost allocations, costs are of no value in decision making." Comment. If you disagree, specify in what ways costs might be useful.
- 9-8 *Evolution of a joint product.* Give an example of a product which at first was treated as scrap, then as a by-product, and ultimately as a joint product.
- 9-9 *Criteria for distinguishing between by-product and joint product.* What criteria are used to distinguish between a by-product and joint product?
- 9-10 *By-product and joint-product methods of accounting.* What is the essential difference between the by-product and joint-product methods of accounting?
- 9-11 *Cost control in a joint cost situation.* Does the fact that unit costs of joint products tend to be arbitrary affect the control of costs?
- 9-12 *Product-line profitability.* "Determining the profitability of product lines tends to be a nonattainable objective in joint cost situations." Comment.

- 9-13 The Atlantic Seaboard Lumber Company's total cost of production during the first year's operations amounted to \$480,000. Six grades of lumber were produced, as shown below:

Grade	Production, thousands of ft	Inventory on hand at end of year, thousands of ft	Selling price, per thousand ft
A	7,200	600	\$35
B	6,000	500	30
C	4,800	400	25
D	3,600	1,600	20
E	1,800	600	15
F	600	300	10
	24,000	4,000	

The company used 100,000 feet of finished grade D lumber in the construction of its warehouse.

*Required:* Calculate the cost of sales to appear on the income statement and the cost of the ending inventories for the balance sheet.

(AICPA adapted)

- 9-14 *Waste and scrap; internal profit measurement.* The Dixie Company manufactures product P, using raw material. There is a normal amount of waste resulting from the processing of this material into the finished product. This waste has no salvage value; therefore the cost of the finished product is considered to be higher because of the waste. In addition to the normal amount of waste which results from processing, scrap which is known as Zilch results from processing. This scrap has an established market value of 20 cents per pound. It costs the Dixie Company 7 cents per pound in distribution costs to dispose of the scrap at the usual market price. The company follows the practice of inventorying this scrap at market value minus selling and disposition costs. The inventory value of scrap is used to reduce the unit production cost of product P.

Production data for the month of January are as follows: Beginning and ending work in process inventories are negligible. There is no abnormal waste or spoilage during the month other than the usual amount of Zilch.

Raw materials R put into production, 8,000 lb costing a total of \$16,000  
Pounds of product P completed, 4,000  
Pounds of Zilch reclaimed during month, 2,000

There is no inventory of Zilch at the beginning of January. There were also no sales of Zilch during the month.

Labor and overhead costs for the month amounted to \$36,000.

1. You are to compute:
  - a. Total cost of product P completed.
  - b. Unit cost of product P completed.
  - c. Inventory valuation of Zilch, January 31.
  - d. The amount by which the 2,000 pounds normal waste increases the unit cost of product P. Assume that waste this month is normal.

2. The Dixie Company utilizes a system of internal profit measurement and is operationally decentralized. Mr. Young is entirely responsible for the production and sale of product P. The selling price of product P averages \$105 per pound, and selling expenses are 7 cents per pound. Mr. Carlson is entirely responsible for the production and sale of Zilch. Performance of these two managers is measured by the profitability results (profit as a percent of sales) of each man's activity.

The controller and the two managers have met to decide the appropriate method of accounting for Zilch for purposes of measuring management performance. The alternatives are:

- (1) Inventory Zilch at market value.
  - (2) Inventory Zilch at market value minus selling and disposition costs.
  - (3) Inventory Zilch at market value minus selling, disposition costs, and a normal profit of 10 cents per unit.
- a. Which alternative should be chosen? Which might Mr. Young prefer? Mr. Carlson?
  - b. Should Mr. Carlson report organizationally to Mr. Young?

- 9-15 *Process costs; by-product costs; departmental cost statements; inventory cost determination.* The Town Company is a manufacturer, producing two principal products known as XO and MO. Incidental to the production of these products, it produces a by-product known as Bypo. The company has three producing departments, which it identifies as departments 101, 201, and 301. Raw materials A and B are started in process in Department 101. Upon completion of processing in that department one-fifth of the material is by-product and is transferred directly to stock. One-third of the remaining output of Department 101 goes to Department 201, where it is made into XO, and the other two-thirds goes to Department 301, where it becomes MO. The processing of XO in Department 201 results in a gain in weight of material transferred into the department of 50 percent because of the addition of water at the start of the processing. There is no gain or loss of weight in the other processes.

The company considers the income from Bypo, after allowing 5 cents per pound for estimated selling and delivery costs, to be a reduction of the cost of the two principal products. The company assigns Department 101 costs to the two principal products in proportion to their net sales value at point of separation, computed by deducting costs to be incurred in subsequent processes from the sales value of the products.

The following information concerns the operations during April:

#### Inventories

	Mar. 31		Apr. 30
	Quantity, lb	Value	Quantity, lb
Dept. 101.....	None		None
Dept. 201.....	800	\$17,160	1,000
Dept. 301.....	200	2,340	360
Finished stock—XO.....	300	7,260	800
Finished stock—MO.....	1,200	18,550	700
Finished stock—Bypo.....	None		None



Inventories in process are estimated to be one-half complete in Departments 201 and 301, both at the first and last of the month.

Costs		
	Materials used	Labor and burden
Dept. 101.....	\$134,090	\$87,442
Dept. 201.....	-0-	31,950
Dept. 301.....	-0-	61,880

The material used in Department 101 weighed 18,000 pounds.

#### Sales prices

- XO—\$29.50 per pound  
MO—\$17.50 per pound  
Bypo—50 cents per pound

Prices as of April 30 are unchanged from those in effect during the month.

You are to prepare the following statements covering the operations of the Town Company. Present all supporting computations in good form.

1. Statement showing costs and production by departments for the month of April. The company uses first-in, first-out to cost out production.
2. An exhibit of inventory values for work in process and finished goods as of April 30.

(AICPA)

9-16

*Accounting for joint products and by-products; process costs; determination of cost of Work in Process Inventory and transfers between departments.* The MCB Corporation produces one principal product designated Main-Line. Incidental to this production, two additional products result, Co-Line and By-Line. Materials are started in Process 1; the three products come out of this process. Main-Line is processed further through Process 2; Co-Line is processed further through Process 3; By-Line is sold without further processing. The following data for February are available:

1. Materials put in Process 1, \$12,000.
2. Conversion costs, Process 1, \$8,000; Process 2, \$4,000; Process 3, \$300.
3. There were no beginning or ending in-process inventories.
4. Production and sales data:

	Quantity produced	Quantity sold	February average sales price	Market price, end of February
Main-Line.....	5,000	4,000	\$6.00	\$6.00
Co-Line.....	3,000	2,000	1.00	.90
By-Line.....	1,000	900	.50	.55

5. Selling and administrative expenses are related to the quantity sold. It is estimated that next period selling and administrative costs will be the same as February actual:



Main-Line, \$2,000

Co-Line, \$800

By-Line, \$36

6. Standard net profit on Co-Line is 10 percent of sales.
7. No profit or loss is realized on By-Line sales.

*Required:*

1. Compute the value of the By-Line inventory and the costs transferred from Process 1 to By-Line units during the period.
2. Compute the value of the Co-Line inventory and the costs transferred from Process 1 to Co-Line units during the period.
3. Copy and complete the following entries:
  - a. Process 1  
Process 2  
Process 3  
Raw Materials and Various
  - b. Process 2  
Process 3  
By-Line Inventory  
Process 1
  - c. Finished Goods—Main-Line  
Process 2
  - d. Finished Goods—Co-Line  
Process 3
  - e. Cash  
Sales—Main-Line  
Cost of Goods Sold—Main-Line  
Finished Goods—Main-Line
  - f. Cash  
Sales—Co-Line  
Cost of Goods Sold—Co-Line  
Finished Goods—Co-Line
  - g. Cash  
By-Line Inventory  
Selling and Administrative Expenses
4. Copy and complete the following income statement:

	<i>Main-Line</i>	<i>Co-Line</i>	<i>By-Line</i>	<i>Total</i>
Sales				
Cost of goods sold				
Gross profit				
Selling and administrative expenses				
Net profit				

(AICPA)

**9-17** *Process costs; by-product costs; departmental statements; joint-product costs.* The H & H Laboratories, Inc., manufactures the chemical product Zoom sold to the automobile industry at \$4.25 a pound. The manufacturing process is departmentalized as follows:

- Dept. 1—mixing
- Dept. 2—cooking
- Dept. 3—cooling
- Dept. 4—packing

Materials X, Y, and Z are issued from stores twice daily for production runs, which are controlled by number and date.

In Department 1, materials X, Y, and Z are weighed and mixed in accordance with a secret formula. In Department 2 the mixture is cooked, and 10 percent of the mixture is lost in evaporation at the end of the departmental process. The cooking process requires several hours, and immediately upon completion the vats containing the remaining 90 percent of the mixture are conveyed on belts through several rooms of different temperatures, comprising the cooling department. In the final stages of this department, the top 80 percent of the mixture is poured out and transferred to Department 4, where it is poured into barrels for shipment. The 20 percent of the mixture that represents impurities and sediments resulting from the cooling process is sold in bulk as a by-product called W, for a nominal selling price of \$1 a pound.

Variation in the length of time in the cooling process or in the temperatures can result in increasing the percentage of by-product to as much as 30 percent of the Department 3 mixture, but the minimum by-product always will be 20 percent.

The research division of the company has discovered a prospective use for the by-product in another field, but it would require the setting up of an additional department and an investment of additional capital to handle a further manufacturing process. This new by-product (Clora-W) would sell for \$5 a pound. To produce this product  $\frac{1}{2}$  pound of new material is added to each pound of the sediment obtained from Department 3. However, processing causes a 40 percent shrinkage of the resulting mixture. Processing Clora-W will add the following costs:

Materials to be added.....	\$1.50 per lb
Variable processing costs.....	\$1.10 per lb of input
Fixed processing costs.....	\$3,092 per month

*Required:* Based on the following cost data and production figures for a 1-month period, the management requests you to prepare statements showing total manufacturing cost and gross profit for each of the following situations assuming that all production is sold:

1. By-product W produced at a rate of 20 percent of Department 3 mixture.
2. By-product Clora-W produced at each of the following percentages of Department 3 mixture: (1) 20 percent; (2) 30 percent.

Materials issues to Department 1: X, 8,000 pounds at \$1; Y, 3,000 pounds at \$1.10; Z, 1,000 pounds at 70 cents.

*Processing costs:*

Dept. 1.....	\$ .37 per lb departmental input
Dept. 2.....	.38 per lb departmental input
Dept. 3.....	.45 per lb departmental input
Dept. 4.....	.45 per lb departmental input

All processing costs in Department 4 may be considered as variable.

(AICPA)

9-18

From the following information concerning Dart Co., prepare a statement showing the estimated cost of producing 13,500 tons of X product for the purpose of bidding on a government contract.

Dart Co. manufactures X, a main product, and Y, a by-product. X is produced and sold by the ton (2,000 pounds.) The raw materials used in production consist of three ingredients, H, I, and J, contained in both the finished main and finished by-product in proportions and at estimated costs per ton set forth below:

H 40% at \$8 per ton

I 36% at \$5 per ton

J 24% at \$7 per ton

The contract for 13,500 tons of X represents 60 percent of the budgeted 1964 production of X by Dart Co.

Main product X is manufactured through four processes, as follows:

Process 1. Ingredients H and I are issued at the outset of process 1; completed work in process is transferred to Process 2.

Process 2. Ingredient H, at the end of Process 2, suffers a 5% weight loss due to evaporation, and 10% of the remaining work in process is sold as waste at a nominal amount of \$6 per ton; completed work in process is transferred to Process 3.

Process 3. Ingredient J, at the outset of Process 3, is mixed with work in process. Ingredient J loses 4% of its original weight, due to evaporation at the end of Process 3.

Process 4. In this final process, the material is separated into main product X and by-product Y in the proportions of 80% and 20%, respectively, and such products are placed in salable form.

Estimated direct labor per ton by process is as follows:

<i>Process no.</i>	<i>Direct labor per ton</i>
1	\$5.00
2	2.50
3	3.00
4	4.00

Manufacturing overhead expense at normal capacity, that is, 75 percent of a total plant capacity of 25,000 tons annually of X, is as follows:

<i>Process no.</i>	<i>Variable</i>	<i>Fixed</i>	<i>Total</i>
1	\$ 60,000	\$30,000	\$ 90,000
2	62,000	18,000	80,000
3	50,000	20,000	70,000
4	40,000	16,000	56,000
Total.....	\$212,000	\$84,000	\$296,000

At the normal capacity level, general manufacturing overhead applicable to the factory as a whole amounts to \$60,000, of which 40 percent is fixed.

It is expected that the units called for by the government contract, couple with the company's curtailed civilian production during 1964, will reach 9 percent of total plant capacity measured in finished units of product X.

Product Y is expected to sell for an estimated \$20 per ton, before deduction for handling, selling, and administrative expenses of \$2.50 per ton.

(AICPA)

9-19

*Production-cost determination; costs and profitability.* Pipe Co. has been in operation for 1 year. It manufactures concrete pipe in lengths of 4 feet and has the necessary equipment to produce the following sizes:

18 in.      30 in.  
24 in.      36 in.

The company has one basic machine to produce pipe. Only one size is made during each working day of 8 hours, the last hour of which is used by the crew for clean up and, as necessary, to change the machine so that a different size can be made the following day. Production during the first year was limited to sizes, 18 to 30 inches inclusive.

You are informed that there is a ready outlet for 36-inch pipe if it were to be produced.

The company has prepared the following exhibit of profit and loss for the year just ended:

Sales .....		\$58,000
Raw materials purchases .....	\$17,657	
Direct labor .....	13,255	
Freight in .....	2,447	
Delivery expense .....	3,582	
Depreciation:		
Factory building .....	600	
Office building .....	280	
Factory machinery .....	3,000	
Office furniture and fixtures .....	200	
Electric power purchased—factory .....	1,519	
Shop supplies .....	2,550	
Office supplies and expenses .....	1,000	
Office salaries .....	5,200	
Telephone and telegraph .....	375	
Repairs and maintenance—factory .....	2,175	
Commissions on sales .....	2,700	
Other factory expenses .....	760	
Miscellaneous general expense .....	200	
Raw-materials inventory—year-end .....		\$ 1,630
Finished-goods inventory—year-end (at estimated cost per ton of \$10) .....		5,990
Profit for year .....	8,120	
	<u>\$65,620</u>	<u>\$65,620</u>

Your review of records discloses the following data as to production and sales:

Pipe diameter, in.	Produced, ft	Sold, ft	Dec. 31			Average production per day, ft	Selling price per ft
			Ft	Lb per ft	Total weight, lb		
18	7,200	6,200	1,000	150	150,000	120	\$2.20
24	10,200	8,120	2,080	250	520,000	100	3.00
30	6,320	5,000	1,320	400	528,000	80	4.00
					1,198,000		

Materials cost in finished pipe is found to be the same per ton throughout the year, regardless of size. Labor and overhead were incurred uniformly throughout the year. The plant foreman tells you that test runs have indicated that 36-inch pipe would weigh 500 pounds per foot and that production should average 64 feet per day. The 36-inch pipe will sell for \$5 per foot.

1. a. Compute the cost of each size of pipe produced during the year on a per foot basis, including material, labor, and manufacturing overhead.  
b. Prepare an exhibit showing which size of pipe would be most profitable to produce.  
c. Compute the value for the closing inventory of pipe of each size.
2. Prepare an estimate of the cost of producing 36-inch pipe, and compare gross profit from producing it with that from producing other sizes.

Note: Carry computations to three decimals.

(AICPA)

9-20

From the following data prepare a statement of operating results of the Zinc Mining and Milling Company in October that will show the operations on the company's own account and its activities in furnishing milling services to others, both for zinc and for lead concentrates. Present all supporting schedules. Carry computations to three decimals.

The Zinc Mining and Milling Company operates several mines and a mill for concentrating ore. The ore as it comes from the mines must be concentrated in the mill before being shipped to the smelters. The resulting zinc and lead concentrates amount to about 5 to 7 percent of the original weight. Both kinds of concentrates go through substantially the same milling processes. Zinc concentrates contain about 60 percent zinc, while lead concentrates contain about 80 percent lead.

The company, in addition to milling the rock produced in its own mines, does commercial milling for other mines in the neighborhood, accepting as compensation 20 percent of the concentrates produced. The amount of concentrates produced from the ores thus brought in is determined by assaying each carload of rock as it is received. This is necessary because (1) the ores from different mines differ in richness and (2) it is not practicable to mill different batches of ore separately.

The mining land and ore deposits are not owned by the company. A royalty of 12 percent of the selling price of concentrates produced from company



ores must be paid to the owners. This royalty accrues as the concentrates are sold, royalty expense being charged and Accounts Payable credited at the end of the month in which sales are made.

The company develops its own power, which is used 40 percent for mining operations and 60 percent in the mill.

Inventories of partially mined rock and of rock in process in the mill are constant and may be ignored for the purposes of this problem.

The following operating data are presented:

Cost of mining.....	\$31,356
Cost of milling.....	11,326
Cost of power.....	6,292
General management.....	5,586
	<u>\$54,560</u>

(The above costs include all labor, supplies, expenses, and depreciation.)

	<i>Tons</i>	<i>Valued at</i>
Mined rock on hand Oct. 1.....	500	\$ 615
Rock mined and brought to the surface in October.....	27,600	
Mined rock on hand Oct. 31.....	1,500	
Rock owned by others milled in October.....	4,600	
Concentrates on hand Oct. 1:		
Zinc—own product only.....	150	3,900
Lead—own product only.....	50	1,800
Concentrates produced in October, both own and for others:		
Zinc.....	1,810	
Lead.....	187	
Concentrates delivered to others after retaining company's share:		
Zinc.....	216	
Lead.....	24	
Concentrates on hand Oct. 31:		
Zinc—own product only.....	125	
Lead—own product only.....	20	
Sales of concentrates in October:		
Zinc.....		66,379
Lead.....		11,001
Market price per ton of concentrates Oct. 31:		
Zinc.....		42
Lead.....		58

It is understood that the mining and milling expenses will be apportioned to the cost of lead and zinc concentrates on the basis of their sales value and that the general management expenses will not be absorbed in the production costs.

10. **Standard Cost Accounting**  
**—Setting Standards and**  
**Calculating Variances**

In previous chapters, most of the discussion has centered around the classification, accumulation, and assignment of *historical* costs of production, i.e., the *actual, incurred* direct-materials, direct-labor, and factory-overhead costs. It has been indicated briefly that for management control purposes the actual costs incurred in a process, cost center, or department during the manufacture of goods should be compared with some type of yardstick.

In Chapter 6, a predetermined type of cost was presented involving the use of normal or predetermined factory-overhead rates. The predetermined overhead rates were used to spread estimated factory-overhead costs over the units of product manufactured during the year. The predetermined normal overhead rate may be thought of as a standard cost, even though, perhaps, it is more accurately an estimated cost. In this chapter and the next, standard costs and their use by management in controlling the operations of the firm will be discussed.

### *The nature of standard costs*

#### **Cost standards**

Accounting standards are "scientifically" predetermined costs which provide a basis for measuring actual performance. Accounting cost standards need not be incorporated into the accounting system. This is a common practice in regard to distribution cost standards. Factory cost standards generally are formally integrated with the cost accounts. When this occurs, the system is referred to as *standard cost accounting*. In this book, it will be assumed that the standards are an integral part of the cost accounting records.

### Standard and actual costs

Standard costs are in contrast to actual costs. Actual costs are historical costs which have been incurred in a past period. Standard costs are established in advance of production. When a standard cost accounting system is used, both the actual and standard costs are reflected in the cost accounts. The difference between the actual and standard cost is called a variance.

Variances indicate the extent to which a desired level of performance, as defined by management, has been attained. Variances may be segregated by department, by cost, and by element of cost, e.g., price and quantity. The extent to which a variance is controllable depends on the nature of the standard, the cost involved, and the particular circumstances that created the variance.

Standard costs may be used in either process or job-order cost systems. However, when a manufacturing company performs a large number of different jobs of relatively short duration, standard costs may prove to be somewhat impractical. In such situations, instead of scientifically establishing standards for each job, it may be more feasible to use cost estimates which were the basis for establishing job prices. Standards lend themselves to activities which tend to be routinized and repetitive and in which products tend to be standardized.

### Estimated, normal, budgeted, and standard costs

The terms "estimated," "budgeted," "normal," and "standard" cost need to be distinguished and their meanings clarified for purposes of discussion. The following definitions will be assumed in this book:

"Estimated cost" is the amount the firm thinks a product or the operation of a process for a period of time actually will cost. Frequently an estimated cost is based upon some average of actual past production cost experience adjusted for changes in economic conditions, efficiency, etc., anticipated in the future. Estimated costs ordinarily include an amount which reflects anticipated waste, spoilage, and inefficiencies which increase unit and total operation and product costs.

"Normal cost" ordinarily has approximately the same meaning as "estimated cost." It is sometimes given the slightly different meaning of an average of costs which have actually been incurred in past periods only, without regard to changes expected in the future.

"Budgeted cost" is the same as either "estimated cost" or "normal cost" in meaning; i.e., budgeted cost is the planned cost, which frequently is based upon an average of past costs adjusted for anticipated future changes. The synonymy of estimated cost, normal cost, and budgeted cost is exemplified by business firms which construct their budgets on the basis of estimated normal cost of manufacturing (abbreviated, of course, to ENCOM). A budget may, however, be constructed in terms of standard cost. Such a budget, then, is called a standard budget. In

this discussion of standard costs and variance analysis, budgets are assumed to be in terms of estimated, or normal, cost rather than standard cost unless indicated to the contrary. Budgets will be discussed in depth in later chapters.

"Standard cost" is the amount the firm thinks a product or the operation of a process for a period of time *should* cost, based upon certain assumed conditions of efficiency, economic conditions, and other factors.

### Types of standards

Conceptually, standards may be classified according to their degree of "tightness" or "looseness" as follows:

1. **Ideal, or theoretical, standards.** Ideal standards are tight standards which in practice may never be attained. There was a tendency on the part of business managements, when standard cost accounting first became popular, to use ideal standards. The underlying assumption was that this would provide the best level of efficiency for operating personnel to strive to attain. An advantage of ideal standards is that they can be used for relatively long periods of time without having to be adjusted. Perfect performance, however, is seldom attainable by men or machines, and ideal standards create a sense of frustration. They are rarely used today.

2. **Average of past costs.** When standards are based on average past performance, they tend to be loose standards. Average past costs may include inefficiencies that should not be incorporated into the standards. Standards of this type sometimes are useful, however, in initially establishing a standard cost system, since such standards can be set with relative ease. If this procedure is followed, it is desirable to gradually replace the standards with ones representing a more meaningful level of performance.

3. **Normal standards.** A normal standard is based on future cost expectations under assumed normal economic and operating conditions. In fact, normal standards tend to be based on past averages adjusted for future expectations. An advantage of normal cost standards is that they do not require frequent adjustment. Normal standards may be useful to management in long-run planning activities and decision making. Normal cost standards are less desirable from the standpoint of performance measurement and short-run decision making.

4. **Attainable high performance.** Conceptually, this type of cost standard represents the best criterion for evaluating performance, and its use is widespread. Standards based on an attainable high performance level include provision for certain operating inefficiencies which are considered unavoidable. It is possible to meet or surpass standards of this type through effective performance.

When standards are based on an attainable high level of performance, a decision must be made as to whether material prices and labor rates are to be based on prevailing levels or on future expectations. Because of the difficulties encountered in anticipating price and rate trends, most



companies tend to rely on existing prices and rates. However, many accountants believe that prices and rates are at least partially controllable. If this viewpoint prevails, it would seem to follow that materials prices and labor rates should be based on changes expected during the coming year. When standard prices and rates are based on expected trends, they are apt to be more useful in short-run management decisions, which automatically are concerned with the future.

### Advantages of standard costs

The following benefits may be obtained from standard costs:

1. Cost standards can be an important instrument in evaluating performance. When standards are realistic, attainable, and properly administered, they can stimulate individuals to perform more effectively. It is perhaps easier for individuals to perform efficiently when they know what is expected of them.

Variance reporting and analysis permit management to operate according to the "principle of exception." In a large organization, it is not possible for higher levels of management to be intimately aware of the problems and possibilities for improvement of the various functions performed throughout the firm. By establishing a control system and focusing attention on out-of-control situations, management is provided with an effective instrument for controlling corporate activities.

2. Variances from standard lead to management cost reduction programs by focusing attention on out-of-control areas. These programs may include improved methods, better selection of men and materials, training programs, improved quality of products, and desirable capital investments.

3. Standard costs are useful to management in the establishment of its plans. The very process of setting standards requires careful planning in such areas as organization structure, assignment of responsibilities, and policies relating to performance evaluation. It should be noted, however, that for planning purposes management may give effect to expected variances from standard, so that its budgets will be as realistic as possible.

4. Standard costs are useful in decision making, particularly if product cost standards are segregated according to variable and fixed cost elements and if materials prices and labor rates are based on expected cost trends during the coming year.

5. Standard costs may result in a reduction in clerical work. For example, under an actual-cost system each item on each materials requisition must be costed separately, if Lifo or Fifo is used. In a large company this is an enormous task, since thousands of requisitions may be issued. Under a standard cost system, at the end of the month, all the items of a particular type need only be multiplied once by the standard cost. In effect, under standard costing, only quantities have to be maintained on stores records. This saving is partially offset, however, by the added cost of establishing and revising standards.



### Limitations to standard costs

While it is relatively simple to categorize the theoretical assumptions underlying the establishment of standards, it is far more difficult in practice to conform to a specified conceptual framework. Degree of tightness or looseness of standards cannot be precisely calculated. Even if management's policies are clearly defined in regard to the type of standards desired, there can be no assurance that standards have been set throughout an organization with the same relative tightness or looseness.

(Standards often tend to become rigid, or inflexible, even in relatively short periods of time. Whereas manufacturing conditions are constantly changing, revisions of standards may occur at infrequent intervals.) Accountants have a natural reluctance to change standards during a year, except under unusual circumstances. Revisions of standards create special inventory problems. For example, a change in the price of a raw material necessitates an inventory adjustment not only for raw materials but also for work in process and finished goods containing this material. When standards are revised frequently, their effectiveness for measuring performance is weakened, since this is like measuring activities by elastic criteria. On the other hand, failure to revise standards for significant manufacturing changes results in inappropriate and unrealistic measurements. ✓

There has perhaps been a tendency to endow standards with greater attributes for measuring performance than they really possess. Isolating the controllable and noncontrollable elements of variances is an extremely difficult task. For example, an unfavorable labor variance in a particular department may superficially appear to be within the control of the department supervisor. Actually, he has little or no control over the hourly rate paid. The inefficiencies may be due to a poor grade of workers employed (personnel department), lack of an adequate training program (top management), poor quality of materials used (incoming inspection or purchasing), or inadequate maintenance of facilities (maintenance department). Frequently, the reason for a variance may be completely inexplicable and may be due to random factors.

During recent years, studies made by some social scientists have cast doubt on the value of standards as a basis for measuring performance. These individuals claim that standards often tend to be regarded as oppressive by workers and department supervisors and that they create attitudes of resistance, rather than act as incentives. As a consequence some managements refuse to use standard costs for controlling factory operations.

Standard costs provide a measure against which to compare the performance of individuals—and to motivate them by spotlighting inefficient performance. Although this management-by-exception technique conserves the time of executives, a different type of motivation and control is preferred by some managements. One such type is the profit-sharing

plan, in which all individuals in the firm are motivated to work at top efficiency and enhance the size of the profits in which they will share.

( It is probably true that the management philosophy underlying standard costs and management by exception is most popular at present in larger firms in which direct supervisors, and more especially top management, may be somewhat removed from operating individuals. The size of the organization and the degree of impersonal relations are also factors which may require a systematized method of controlling the many operating departments.

( An awareness of these potential limitations of standard costs is essential in order to use them with maximum effectiveness. Overcoming these difficulties represents a great challenge to the managerial accountant. New concepts involving the use of standards in a participative type of management environment are becoming increasingly popular. Properly used, standards can be a powerful instrument to management in planning, control, and decision making.

### *Setting the standards*

The discussion which follows is concerned with procedures for establishing standard costs. In order to illustrate these procedures, reference will be made to the Nielsen Company, which manufactures men's ties and handkerchiefs. The company's factory is divided into four processes: cutting, sewing, pressing, and boxing. A separate manager is responsible for each of these cost centers.

In the cutting process, the raw material, e.g., linen, silk, is first arranged in layers. A pattern is then applied and markings made. The raw material then is machine-cut into the desired size. In the sewing operation, a hem is attached to the handkerchief. The product is finally pressed and boxed and moved to the finished goods storeroom or shipped to customers.

#### **The standard cost card**

A standard cost card is prepared for each product manufactured. This card discloses the various operations that the product passes through, materials used, and total and unit cost of raw materials, direct labor, and factory overhead. It is desirable to show separately both the cost for each process and the cumulative cost. This facilitates the pricing of inventories and scrap. Exhibit 10-1 is an example of a standard cost card for the Nielsen Company.

#### **Materials cost standards**

The standard cost of raw materials consists of two elements, quantity and price. Materials quantity standards should normally include not only the raw ingredients but also purchased parts, coating materials, crates, cartons, and packing materials which are visible in, or can be directly

## Exhibit 10-1

THE NIELSEN COMPANY  
Standard Cost Card  
Cost per 100 units

Product Handkerchief 105

Process	Materials			Labor		Overhead		Total process cost	Waste allowance	Cumulative unit cost
	Item	Quantity, per 100 units	Price	Hours per 100 units	Rate	Unit cost	Rate per hr	Unit cost		
Cutting.....	Linen	40 yd	\$ .075(yd)	.4	\$3.00	\$1.20	\$3.75	\$1.50	\$ .30	\$ 6.00
Sewing.....	Hem	160 yd	.0031(yd)	.357	2.80	1.00	3.00	1.07		8.57
Pressing.....	-0-	-0-	-0-	.25	2.80	.70	4.00	1.00		10.27
Boxing.....	Box	33.3*	.027(ea)	.5	2.60	1.30	3.00	1.50		14.27
	Supplies									
						\$4.70		\$5.07	\$ .30	
						\$4.20		\$13.97		

\* Three handkerchiefs per box.

identified with, the product. The standard quantities generally are developed by engineers and consist of the most economical materials consistent with product design and quality. In departments where a mixing of materials occurs, standard mix formulas are established. When many different kinds of raw materials are required for a product, the types and standard quantities of each raw material may be itemized on a form called a *standard bill of materials*. Materials cost standards presume the existence of adequate materials planning and control procedures and the use of materials whose design, quality, and specifications are standardized.

Spoilage allowances, which include shrinkage, waste, and scrap, should be included in standard product costs only for amounts regarded as normal or unavoidable. In Exhibit 10-1, it will be observed that the management of the Nielsen Company has provided a waste allowance of 30 cents per 100 units in the cost of style 105. This constitutes approximately a 95 percent recovery of the cost inputs in the cutting operation. It represents unavoidable losses incurred in the cutting of materials. Losses of this type are common, e.g., smoke losses in a foundry; turnings, grindings, chips, etc., in metalworking; evaporation in a chemical process; scrap in an assembly operation. Standard allowances are established by engineers, based on normal company or industry experience. Spoilage in excess of such allowances are treated as a *materials usage variance*. In providing a standard allowance for spoilage, some companies include only the cost of materials lost; others include total factory costs incurred to the point where the spoilage occurred. The latter viewpoint seems more realistic, since the spoilage loss actually includes labor and overhead as well as materials.

The type of raw materials price standard used depends upon management policy. The standard may be based on recent-past average prices, current prices, or expected prices. Raw materials price standards which are based on what the prices are expected to be during the period in which the standards will be in effect are particularly useful in short-run decision making. However, many companies are reluctant to anticipate price trends and prefer to rely on prices in effect at the time the standards are established as well as on announced future price changes.

The precise treatment of related materials costs such as freight, materials handling, inspecting, receiving, and storing, as was indicated in Chapter 3, varies from firm to firm. When these costs are attached directly to the raw materials, by means of a predetermined rate, more refined material standards are obtained.

The standard materials cost, exclusive of the allowance for waste, for item 105 of the Nielsen Company is \$4.70 per 100 units, as shown in Exhibit 10-1. The standard quantity of hem band allowed per 100 handkerchiefs is 160 yards, and the standard price per yard for hem is .3 cent, resulting in a unit cost for materials in the sewing process of 50 cents per 100 handkerchiefs.



### Labor cost standards

Standard labor cost consists of two elements, standard, or allowed, production per hour and standard hourly wage rate. Standard production allowances may be based on an engineering determination of what represents a good and attainable level of performance. Time and motion studies frequently are used to set labor standards, after consideration has been given to the most efficient routing of products through the factory, layout of machines, and mechanical aids for workers. Normally, only allowances recognized by accepted engineering practices, such as personal habits, fatigue, inherent delay, etc., are provided for in the standard.

Other methods may be used to establish labor time standards. Engineers sometimes resort to synthetic time standards. These are based on tables containing standard time allowances for various motions and other elements involved in a job. Synthetic time standards require a very careful and detailed job description.

Averages of past performance often are used as time standards, particularly when a standard cost system is initially installed. Since past average labor performance data are relatively easy to procure, the system can be installed much more rapidly than if time and motion studies are used. However, these are not "scientific" standards, and they should gradually be replaced by engineered standards.

Some companies use test runs as the basis for setting labor time standards. Often the test runs are needed to determine the estimated cost of a new product in order to establish a selling price. Standards set on the basis of test runs generally are unsatisfactory, since it is difficult to simulate real operating conditions on a pilot basis. For example, learning experience on the part of workers is apt to result in timesaving.

The setting of labor rate standards requires a knowledge of the operations to be performed, the grade of labor desired, and the average rate per hour expected to be paid. The hourly rate may be based upon a union contract. In general, a labor rate variance is not controllable, at least by lower levels of management. However, if the actual rate is based on a contractual agreement, a rate variance may result from the use of higher or lower grades of labor than is provided for in the standard. This type of rate variance is more apt to be controllable by department supervisors.

Several different kinds of unit labor costs may occur. This will be illustrated by reference to the Nielsen Company. In the sewing process, time and motion study engineers have made a study of the motions involved in sewing the hem to the handkerchief. Each employee working at a good pace ideally should be able to produce 300 handkerchiefs per hour (ideal standard). However, because of union requirements agreed to by management, some time must be provided for rest and personal habits. This factor plus certain unavoidable delays (such as sewing-machine-needle breakages) reduces the output per hour to 280 units (attainable high standard).



Regardless of productivity, each employee in the sewing process is paid \$2.80 per hour in accordance with the union contract. This is also the standard cost per hour of direct labor. For production in excess of the standard, employees earn profit-sharing points. Records maintained for the past 18 months indicate that although the output of individual employees varies considerably on either side of the standard, all output of the sewing process is, on the average, processed at the rate of 240 per hour (normal).

In preparing its annual budget in January, the Nielsen Company estimated that improved personnel selection policies will increase the average output rate to 260 per hour (estimated or budgeted). During March, the month considered in this illustration, an output of 160,000 units resulted from 640 working man-hours. Direct laborers were paid a total of \$1,792. Actual output thus amounted to 250 per hour.

With direct labor paid at the rate of \$2.80 per hour, the possible types of sewing process direct-labor cost for each unit of product as defined above are shown in Exhibit 10-2.

The standard cost which is used in the Nielsen Company's cost accounting system is based upon an attainable high standard. The standard unit direct-labor cost in the sewing process is \$1 (Exhibit 10-1). The standard *quantity* of direct-labor hours in the sewing process for each 100 handkerchiefs processed is  $1/280$  hour (.357 hour). The standard direct-labor *rate* is \$2.80 per direct-labor hour. The \$1, i.e.,  $.357 \times \$2.80$ , is the standard direct-labor cost of the sewing process per 100 units of product.

The actual direct-labor rate per hour was \$2.80, which is also the standard rate. Since wage rates in many industrial firms are determined by a union contract, it is realistic to recognize that the contractual rate

#### Exhibit 10-2

#### THE NIELSEN COMPANY Sewing Department Different Types of Unit Labor Costs

	Output per hr, pieces	Hours required, per 100 units	Direct-labor wage rate per hr	Direct- labor cost per 100 units
Standard Cost:				
Based on ideal standards...	300	(.333 ×	\$2.80)	\$ .933
Based on attainable high standards.....	280	(.357 ×	\$2.80)	1.00
Budgeted or estimated cost...	260	(.385 ×	\$2.80)	1.078
Normal cost (past experience)	240	(.417 ×	\$2.80)	1.168
Actual cost (current period)...	250	(\$1,792 ÷ 160,000/100)*		1.12

\* Total direct-labor wages and output for the current period.

is, in essence, the standard rate, since during the period of the contract it ordinarily cannot be reduced. Within each department, however, it is possible to have several grades of labor paid at different rates, so that the average actual labor cost may differ from the standard labor cost. Wage rates may be based upon different skills or experience, or both. For simplicity, in the Nielsen case a single wage rate is assumed in the sewing process.

### Types of labor variances

In the sewing process during the month of March, the actual production was 160,000 units, and the actual direct-labor hours worked was 640 hours. The standard direct-labor hours worked amounts to  $571\frac{3}{4}$  (i.e., 160,000 units of output produced  $\times$  .357 standard direct-labor hour per 100 units). It should be emphasized that *the standard direct-labor hours for the month means the number that should have been worked, based on the items actually produced*. The standard work done is measured by the actual output of 160,000 sewed handkerchiefs. This is sometimes referred to as *productive* standard hours.

The actual direct-labor cost incurred in the sewing process during March was \$1,792. The standard direct-labor cost (which is the amount that *should have been incurred* to do the work accomplished, namely, the production of 160,000 sewn handkerchiefs amounts to \$1,600. This amount is computed either as  $571\frac{3}{4}$  standard hours  $\times$  \$2.80, or as 160,000 handkerchiefs  $\times$  \$1 per 100 units.

The arithmetic difference between the \$1,600 standard direct-labor cost and the \$1,792 actual direct-labor cost incurred in the sewing process during March is \$192 and is called the *standard direct-labor cost variance*. Variances will be discussed in more detail later in this chapter. It is sufficient to note here that the standard direct-labor cost variance may be analyzed as, or broken down into, a labor *quantity* (or efficiency) variance and a labor *rate* (or price) variance. In this illustration, since the actual and standard labor rates are identical, only a labor quantity variance occurs, as shown below:

640 direct-labor hours actually worked at an actual wage rate of \$2.80.....	\$1,792
Less: $571\frac{3}{4}$ standard direct-labor hours worked at a standard wage rate of \$2.80.....	1,600
Equals: $68\frac{1}{4}$ excess (inefficient) hours at a standard wage rate of \$2.80 (this may also be computed as the arithmetic difference between \$1,792 and \$1,600).....	\$ 192

This variance means that  $68\frac{1}{4}$  more hours actually were worked than should have been worked to complete the actual production. This resulted in a loss of \$192 due to inefficiency, indicating that management action should be taken to improve the efficiency of employees in the sewing process.

## Exhibit 10-3

THE NIELSEN COMPANY  
Sewing Department  
Types of Labor Costs and Variances

		Total cost, 160,000 units	Cost per 100 units
	Normal past cost	\$1,869	\$1.168
	Actual current cost	1,792	1.12
Variation of actual cost from planned or budgeted cost (budget variance)	Estimated (budgeted cost)	1,725	1.078
Variation of actual cost from standard cost (standard cost variance)	Budgeted variance from standard		
	Attainable high standard	1,600	1.00
Unavoidable inefficiencies, normal machine breakdown, employee rest periods, etc.	Ideal standard	1,493	.933

Exhibit 10-3 portrays different possible types of variances for the direct-labor element of production cost in the sewing process. It is the variance of actual cost from standard cost, i.e., standard cost variance, with which management is most concerned for control purposes. An unfavorable variance indicates a situation which is out of control. It is the function of line management to investigate the worst situations and attempt to get them under control, if possible.

In Exhibit 10-3, the area between the actual cost line and the budgeted cost line is known as a *budget variance*. (It is also called *spending* or *controllable variance*.) In the literature of cost accounting, budgeting, and control, there frequently is confusion about the difference between the relationship between standard cost variances and budget variances. Both types of variance represent the variation of (or the arithmetic difference between) actual cost and some yardstick (the budget or the

standard). In terms of the connotations of budgeted cost and standard cost presented earlier in this chapter, it is suggested that both the budget cost and the standard cost represent cost limits. Budget costs are the *maximum cost* which should be tolerated in a department in order that the individual departments or processes may do their part in fulfilling the firm's profit plan as indicated by the budget. Standard costs, on the other hand, may be viewed as the *minimum cost* toward which the individual departments or processes should strive.

The direct-labor *budget variance* in Exhibit 10-3 amounts to \$67. This is calculated as follows:

For the production level of 160,000 units of sewed handkerchiefs, the budget allowance is \$1.078 direct-labor cost per 100 units, or \$1,725. The actual direct-labor cost for this level of operations amounts to \$1,792. The budget variance of \$67 is the difference between \$1,792 and \$1,725. Thus, the cost is beyond the maximum indicated by the budget.

The first efforts should be to get the actual cost down to the budget maximum and then to work toward the minimum cost indicated by the standard cost. Because of the importance in management control of timeliness in reporting variances and taking managerial action, variances from standard (particularly for direct materials and direct labor) frequently are calculated and reported each day on the production activity for that day. Comparisons of actual costs with budget costs often are made less frequently, such as monthly.

In Exhibit 10-3, the area representing the difference between budgeted cost and standard cost (the attainable high standard) represents the amount of inefficiencies (\$125) which have been "allowed for" in the budget. Stated another way, this amount of variance has been budgeted, or planned, and thus it is a *budgeted variance* (not to be confused with the term "budget variance," which is the variation of actual cost from budgeted cost).

Many firms budget, or "plan for," variances of actual costs from standard. Obviously, those which do not budget, or plan for, such variances have *standard budgets*. Where standard budgets are used, the variances of actual cost from standard cost (standard cost variances) will be identical with variances of actual cost from budgeted cost (budget variances).

The Nielsen Company case has been presented to provide something concrete from which to gain an overview and general idea of yardsticks against which actual cost performance might be measured. The tightness of the measure used by a particular firm depends among other things upon (1) the requirements, demands, and power of employee unions with respect to employee performance measures and (2) the philosophy of management.

Basically, the yardstick may simply be the budget which is based upon past performance (which must be assumed to have been satisfactory profitwise) adjusted for future expectations. One theory of business



activity is that firms are interested in satisfactory profits and performance (satisfying behavior) rather than in maximum profits (maximizing behavior). In such a situation, a budget based upon satisfactory performance in past periods might be used by management as the performance goal. This philosophy probably is more prevalent in "good times" than when economic conditions are depressed and the firm's efforts are directed toward minimizing losses.

### Factory-overhead cost standards

The task of setting standards for direct materials and direct labor is simpler in concept than the task of determining a standard factory-overhead cost. Standards for the variable portion of factory overhead are set and used in essentially the same way as those for direct labor and direct materials. Variable factory overhead usually is indirect, as well as variable, in contrast with the direct nature of the labor and materials costs which also are variable.

The variable factory-overhead items ordinarily consist either of indirect labor or some commodity such as utilities or indirect supplies for which usage standards for a given quantity of production can be determined. Variable factory overhead is deliberately placed in a direct relationship to products through the use of a variable overhead rate. Semivariable factory overhead may be included with variable factory overhead, since semivariable costs are variable over a given range of activity.

The difficult task is the determination and use of standard costs for product-costing and control purposes for the *fixed element of factory overhead*. Fixed factory overhead consists mainly of the expired cost of machines and facilities which will be incurred by the firm regardless of the level of productive output. The responsibility for the incurrence of these costs ordinarily is not at the operating level but is rather at the top-management level. The degree of utilization of these facilities depends upon sales volume and the policy regarding inventory levels, which also are not a responsibility of production supervision.

Thus, the use of standard costs for fixed factory overhead is rather meaningless for purposes of top-management control of production operations. While a fixed factory-overhead variance may have sales implications, better indicators of the effectiveness of salesmen are available—such as a decline in sales or a variance of actual sales from budgeted sales.

The predetermined or normal factory-overhead rate which is developed for purposes of product costing will be called the *standard factory-overhead rate* in standard cost discussions. The major usefulness of this standard factory-overhead rate, which typically includes a mixture of variable, semivariable, and fixed overhead costs, is in product costing and in planning, rather than in management control. However, the factory-overhead rate can be converted into a control instrument by separating the elements and establishing dual rates, one for variable



*Exhibit 10-4*

THE NIELSEN COMPANY  
Pressing Department  
Fixed Factory-overhead Rates  
Under Various Measures of Capacity  
(Basis: direct-labor hours)

	<i>Capacity measure, direct-labor hr</i>	<i>Fixed factory-overhead rate per hr</i>
Maximum capacity.....	12,500	\$2.40 (\$30,000 ÷ 12,500)
Practical capacity.....	10,500	2.86 (\$30,000 ÷ 10,500)
Normal capacity.....	10,000	3.00 (\$30,000 ÷ 10,000)
Expected sales.....	10,300	2.91 (\$30,000 ÷ 10,300)
Actual level.....	10,200	2.94 (\$30,000 ÷ 10,200)

factory overhead and another for fixed factory overhead. Many companies are now doing this.

The standard overhead rate, expressed as so many dollars per direct-labor hour or machine hour, or as a percentage of direct-labor dollars or prime costs, for example, may be based on one of several possible activity levels. Exhibits 10-4 and 10-5 demonstrate the effect of the various capacity measures on the amount of factory-overhead costs attached to product and the amount shown as idle capacity loss. The definition of these various measures of capacity depends on engineering estimates and management policy, i.e., regarding number of working days, number of shifts, etc. Idle capacity loss exists when production activity is insufficient to absorb all the incurred fixed factory overhead. These exhibits are based on production activity data for the Pressing Department of the Nielsen Company for a year, and it is assumed that the standard factory-overhead rate is based on direct-labor hours.

Estimated fixed factory overhead for the year amounts to \$30,000. Since idle capacity loss is due to unabsorbed fixed or indirect costs of facilities, for simplicity purposes the variable or direct factory-overhead costs are not included in the illustration. Direct-labor hours for the year, as a measure of the various capacities upon which the standard factory-overhead rate might be based, are indicated in Exhibit 10-4, as are the various standard factory-overhead rates based on each of these capacities. Some of the rates are rounded and therefore are approximated amounts. Assuming that actual direct-labor hours worked during the year amounted to 10,200 the amount of incurred factory-overhead costs attached to product and the amount of idle capacity loss for the year are shown in Exhibit 10-5.

**Exhibit 10-5**

**THE NIELSEN COMPANY**  
**Pressing Department**  
**Fixed Factory-overhead Costs Absorbed**  
**under Various Measures of Capacity**  
 (Actual level: 10,200 hours)

<i>Capacity measure</i>	<i>Fixed factory-overhead costs attached to production output (cost of goods manufactured)</i>	<i>Idle capacity loss</i>
Maximum capacity.....	\$24,480 (10,200 × \$2.40)	\$5,520 (2,300 × \$2.40)
Practical capacity.....	29,172 (10,200 × 2.86)	858 ( 300 × 2.86)
Normal capacity.....	30,600 (10,200 × 3.00)	-600 ( 200 × 3.00)*
Expected sales.....	29,682 (10,200 × 2.91)	291 ( 100 × 2.91)

\* Overtime gain.

### Measures of capacity and factory-overhead standards

The different amounts of costs absorbed under the various measures of capacity is related to the question of how tight or loose are the standards upon which standard materials cost and standard labor cost are based. The standard (or predetermined, normal) overhead rate based upon direct-labor hours as the measure of production activity, it will be recalled, is calculated as follows:

$$\frac{\text{Estimated or budgeted factory-overhead for the year}}{\text{Estimated or budgeted direct-labor hours to be worked}}$$

The direct-labor hours in the denominator might be the number of hours based upon any of the following:

1. Maximum or full capacity (ideal standard)
2. Practical capacity (attainable standard)
3. Normal capacity (average of past periods)
4. Budgeted capacity (expected level of performance)

Practical capacity represents the production level which, for all practical purposes, is the maximum level attainable. The difference between maximum capacity and practical capacity is made up of the estimated "unavoidable" factors of machine down time, rest periods, etc. The fact that a plant may "operate at 110 percent of (practical) capacity" simply indicates that the lost time due to these "unavoidable" factors actually was less than estimated in calculating practical capacity (by adjusting the maximum capacity measure). In other words, some of these factors actually were avoidable in the period under consideration.

Normal capacity represents the normal level of operations actually operated at in past periods. It is based on ability to produce and sell.

Budgeted capacity is the activity level budgeted for the coming period based on expected sales.

Since the main purpose of a standard factory-overhead rate is to attach factory-overhead costs to products, the choice of any particular basis for the rate affects the amount of the pool of factory-overhead costs which is attached to product and the amount which is recognized as an idle capacity loss.

From an external, social point of view, the idle capacity loss represents an economic failure to utilize existing facilities productively. The idle capacity loss thus is an index of the failure to produce at a level which fully utilizes the firm's facilities. This inadequate production may be due to lack of sales orders, which in turn may be caused by general economic conditions. When it is considered important to recognize idle capacity losses, the practical capacity basis for the standard overhead rate is appropriate.

From a top-management point of view, the firm may be operating at the highest production level possible, considering the factors over which the firm has control. In other words, the "social waste" indicated by the idle capacity loss may be due to factors over which the firm has no control.

The most commonly used basis for setting factory-overhead rates is normal capacity. The managements of companies using this measurement of capacity believe that overhead should be charged to products on the basis of normal activity, which gives effect to long-term sales trends as well as available plant and facilities.

### Setting the standard factory-overhead rate

As has been indicated, the standard factory-overhead rate is derived by dividing the budgeted factory-overhead costs at the budgeted level of operations by the activity base, e.g., direct-labor hours or machine hours. Referring to Exhibit 10-1, it will be seen that the standard factory-overhead rate for the pressing department of the Nielsen Company is \$4 per

#### Exhibit 10-6

#### THE NIELSEN COMPANY Pressing Department Calculation of Standard Factory-overhead Rate (Annual normal capacity: 10,000 hr)

	<i>Budgeted overhead</i>	<i>Rate per hr</i>
Budgeted variable overhead.....	\$10,000	\$1
Budgeted fixed overhead.....	30,000	3
Total.....	\$40,000	\$4

direct-labor hour (standard). The calculation of the rate is based on annual normal capacity of 10,000 hours (Exhibit 10-4) and appears in Exhibit 10-6.

### Calculating variances

#### The materials price variance

The difference between actual and standard cost of materials used is reflected in two variances: the materials price variance and the materials usage variance.

The materials price variance represents the difference between the standard cost of the *actual* quantities purchased and the actual cost of these materials. Referring to Exhibit 10-1, assume that the Nielsen Company purchased 80,000 yards of linen at 7.6 cents per yard. The materials price variance would be calculated as follows:

Actual cost of linen purchased (80,000 yd @ \$.076).....	\$ 6,080.000
Standard cost of actual linen purchased (80,000 yd @ \$.075).....	6,000.000
Unfavorable materials price variance.....	\$ 80.000

Or

Actual cost, per yd.....	\$ .076
Standard cost, per yd.....	.075
Price variance, per yd.....	\$ .001
Yards purchased.....	80,000.000
Unfavorable materials price variance.....	\$ 80.000

The materials price variance may be caused by a mixture of factors including changes in prices, uneconomical size of purchase orders, shortage of supply, rush orders, poor purchasing procedures, excessive freight charges, and failure to take discounts allowed. In practice, it is extremely difficult to separate the controllable from the noncontrollable factors, and the price variance tends to have only limited value, if any, from a control standpoint.

Although the materials price variance may not be controllable, it provides management with important information for purposes of planning and decision making. A price variance constitutes a leakage from planned, or budgeted, profits. A knowledge of the nature and extent of price variances may permit management to increase product prices, use substitute materials, or find other offsetting sources of cost reduction. For this reason, if many raw materials are used, it is desirable to segregate the price variance according to major categories of materials, e.g., lumber, paints, hardware, steel. This facilitates an identification of the raw materials price variance with products manufactured.

#### The materials usage variance

The materials usage, or quantity, variance results from using more or less raw materials than provided for by the material standards. The



materials usage variance is the difference between the actual quantities of materials used at standard prices and the standard cost of materials allowed based on *actual* production.

Assume that the Nielsen Company produced 150,000 handkerchiefs of style 105 during a particular month. In producing these units, the cutting department used 65,000 yards of linen. The calculation of the materials usage variance, based on these facts, would be as follows:

Actual cost of materials used at standard price (65,000 @ \$.075).....	\$4,875
Standard cost of materials used (150,000 @ \$3 per 100 units).....	4,500
Unfavorable material usage variance.....	<u>\$ 375</u>

Or

Actual quantity of materials used, yd.....	65,000
Standard quantity, yd (150,000 units @ 40 yd per 100 units).....	60,000
Excess quantity used, yd.....	5,000
Standard cost, per yd.....	<u>\$.075</u>
Unfavorable materials usage variance.....	<u>\$375</u>

It will be noted in Exhibit 10-1 that the Nielsen Company has provided a waste allowance in the cutting department of 30 cents per 100 handkerchiefs. This represents an offsetting credit against the actual waste loss. Since the waste allowance on handkerchief 105 is based on conversion costs as well as materials lost, it is theoretically incorrect to treat the entire waste allowance as a reduction of the unfavorable materials usage variance. One possible treatment is to allocate the waste allowance credit among the materials usage variance, the labor efficiency variance, and the factory-overhead budget variance. A less complicated method is to show the waste allowance as a separate (credit) variance and report it together with other variances on internal management reports.

A materials usage variance may be caused by many different factors including the purchase of inferior materials, poor inspection, labor inefficiency, improper engineering specifications, theft, and defective tools or machines. It cannot be automatically assumed that the materials usage variance is controllable by a department supervisor. Nor can it necessarily be assumed that a favorable materials usage variance is advantageous to the company. There may be an interrelationship between variances. For example, a favorable materials usage variance may be related to an unfavorable labor efficiency variance; i.e., labor may have conserved materials by operating more carefully and at a slower output rate. Proper variance analysis requires a careful investigation of the actual causes.

### Labor rate variance

The labor rate, or price, variance represents the difference between the actual and standard rate per hour multiplied by the actual hours worked. Although the Nielsen Company's standard rates are based on the union



contract, a rate variance could occur by using higher or lower grades of labor than provided in the standard period.

Assume that during a particular month the actual payroll in the sewing department of the Nielsen Company consisted of 600 hr @ \$2.85, or \$1,710. The calculation of the labor rate variance would be as follows:

Actual direct labor costs (600 hr @ \$2.85)	\$1,710
Actual hours at standard rates (600 hr @ \$2.80)	1,680
Unfavorable labor rate variance	<u>\$ 30</u>

Or

Actual rate per hour	\$ 2.85
Standard rate per hour	2.80
Rate variance, hr	\$ .05
Actual hours worked	600
Unfavorable labor rate variance	<u>\$ 30</u>

### Labor efficiency variance

The labor efficiency, or quantity, variance represents the difference between the actual hours worked and the standard allowed hours (based on *actual* production) multiplied by the standard hourly rate.

Assume that in the sewing department of the Nielsen Company 160,000 handkerchiefs of style 105 were produced in a particular month and that 640 actual direct-labor hours were incurred. As indicated earlier in this chapter, based on these facts, the calculation of the labor efficiency variance would be as follows:

Actual hours worked at standard rate (640 hr @ \$2.80)	\$1,792
Standard labor cost of production (160,000 units @ \$1 per 100 units)	1,600
Unfavorable labor efficiency variance	<u>\$ 192</u>

Or

Actual hours worked	640
Standard hours allowed (160,000 units $\times$ .357 standard hr per 100 units)	571 $\frac{1}{2}$
Labor inefficiency, hr	68 $\frac{1}{2}$
Standard hourly rate	\$2.80
Unfavorable labor inefficiency variance	<u>\$192</u>

### Two-variance overhead analysis

The net factory-overhead variance, i.e., the difference between factory overhead applied to production and actual overhead incurred, may be analyzed as either two or three variances. The two-method overhead variance analysis, consisting of a budget and volume variance, was described in Chapter 6. It will be reviewed here merely to round out the discussion on standard costs.

In order to illustrate the calculation of these variances, assume that at

the close of the year the following facts applied to the pressing department of the Nielsen Company:

Actual hours worked.....	9,500
Standard hours.....	9,400
Actual variable factory overhead.....	\$9,600
Actual fixed factory overhead.....	\$30,000
Standard variable overhead rate, per hr (Exhibit 10-6).....	\$1
Fixed factory-overhead rate, per hr (Exhibit 10-6).....	\$3

The net overhead variance is \$2,000, as shown below:

Standard factory overhead applied to production (9,400 standard hr @ \$4).....	\$37,600
Actual factory overhead.....	39,600
Net unfavorable factory-overhead variance.....	<u>\$ 2,000</u>

The budget variance is calculated as follows:

Actual factory overhead.....		\$39,600
Budgeted factory-overhead allowance (adjusted to actual level):		
Fixed.....	\$30,000	
Variable ( $\$1 \times 9,400$ standard hr).....	9,400	39,400
Unfavorable budget variance.....		<u>\$ 200</u>

In practice, the budget, or spending, variance may be partially due to fixed costs deviating from the budget, e.g., higher rates of pay for supervisors than budgeted, more actual depreciation, insurance, or taxes than budgeted. If, for example, the actual fixed factory overhead had been \$30,100 instead of \$30,000 as budgeted, the unfavorable budget, or spending, variance would have been \$300 instead of \$200.

Since the fixed factory overhead has been assumed to remain constant, i.e., as budgeted, the budget variance applies entirely to variable overhead and also may be calculated as follows:

Actual variable factory overhead.....	\$9,600
Budgeted variable overhead allowance ( $\$1 \times 9,400$ standard hr).....	9,400
Unfavorable budget variance.....	<u>\$ 200</u>

The \$200 budget variance actually consists of several different individual overhead cost variances, e.g., indirect labor, supplies, repairs. A comparison between the actual amount of each of these costs and the budgeted allowances will be presented in the factory overhead control report prepared for the pressing department.

The volume variance, or capacity variance, indicates the extent to which fixed factory-overhead costs have been absorbed by production. It is calculated as follows:

Budget overhead allowance.....	\$39,400
Overhead applied to production.....	<u>37,600</u>
Unfavorable volume variance.....	<u>\$ 1,800</u>

Or

Budget level, hr.....	10,000
Actual level, standard hr.....	<u>9,400</u>
Idle capacity, hr.....	600
Fixed factory-overhead rate.....	<u>\$3</u>
Unfavorable volume variance.....	<u>\$1,800</u>

### Three-variance overhead analysis

In the three-variance analysis, factory overhead is applied to production in the same manner, i.e., the standard overhead rate multiplied by the number of standard hours. Thus, the net overhead variance between overhead applied and overhead actually incurred remains the same: \$2,000 in our illustration. The essential difference between the two-variance method and the three-variance method of overhead analysis is that under the latter procedure variable factory overhead is presumed to vary with, or is allowed to the factory on, the basis of *actual* hours rather than standard hours.

Under the three-variance method, the following variances are derived:

1. Budget, or spending, variance. This represents the difference between actual overhead incurred and the budget adjusted to the actual level, expressed in *actual* rather than standard hours. Using the data for the pressing department of the Nielsen Company, this variance is calculated as follows:

Actual overhead.....		\$39,600
Budgeted overhead adjusted to actual level:		
Fixed.....	\$30,000	
Variable (\$1 × 9,500 actual hr).....	<u>9,500</u>	39,500
Unfavorable budget variance.....		<u>\$ 100</u>

2. Efficiency variance. This is the difference between actual and standard hours worked, i.e., labor efficiency in hours multiplied by the standard factory-overhead rate. This is based on the assumption that the cost of labor inefficiency includes factory overhead as well as labor. For the pressing department of the Nielsen Company, this amounts to \$400 as shown below:

Actual hours worked.....	9,500
Standard hours.....	<u>9,400</u>
Labor inefficiency variance, hr.....	100
Standard overhead rate.....	<u>\$4</u>
Unfavorable efficiency variance.....	<u>\$400</u>

3. The volume, or capacity, variance. Under the three-variance method, this represents the difference between the budget adjusted to the actual

level, expressed in *actual* hours, and the overhead that would have been applied to production had there been no labor inefficiency, i.e., actual hours multiplied by the standard overhead rate. The calculation of the volume variance for the pressing department is shown below:

Budget adjusted to actual level.....	\$39,500
Overhead applied, based on <i>actual</i> hours ( $9,500 \times \$4.00$ ).....	38,000
Unfavorable volume variance.....	\$ 1,500

Under the two-variance method, the volume variance amounted to \$1,800, whereas it is only \$1,500 under the three-variance method. This difference is equal to the 100 hours of labor inefficiency multiplied by the standard fixed factory-overhead rate of \$3 per hour. In effect this means that under the two-variance method, the volume variance is partially due to labor inefficiency; i.e., the level of operations would have been higher had labor functioned at standard efficiency. This is illustrated below:

Fixed factory overhead actually absorbed (9,400 standard hr @ \$3)....	\$28,200
Fixed factory overhead that would be absorbed if labor worked at standard efficiency (9,500 actual hr @ \$3).....	28,500
Portion of volume variance under two-variance method due to labor inefficiency.....	\$ 300

The three-variances must of course equal the net overhead variance, as is indicated below.

Budget variance.....	\$ 100
Efficiency variance.....	400
Volume variance.....	1,500
Unfavorable net overhead variance.....	\$2,000

### Evaluation of the three-variance method

The principal value of the three-variance method of overhead analysis is derived from isolating the efficiency variance and basing the budget allowance on actual rather than standard hours. It is questionable, however, whether the three-variance method really introduces additional precision in the analysis of overhead. The efficiency variance is based on the assumption that a real loss in the use of fixed facilities occurs as a consequence of labor inefficiency. This would only occur under the rare circumstances where a plant operates at maximum capacity.

Under the two-variance method, the budget variance, which is regarded as largely controllable by department supervisors, includes any increase or decrease in variable factory overhead arising from labor inefficiency. This occurs because the actual overhead is compared with a budget allowance based on *standard* hours. Under most circumstances, this would seem to be a more realistic approach to overhead variance analysis.



### Review and change of standards

For control purposes, it is important that the standard against which actual performance is measured should be current. Hence, standards should be reviewed periodically to ensure that recognition has been given to changes in production which have taken place. For example, a change in the grade of materials used in the manufacture of a product should be reflected in the standard, so that variances used for control purposes are realistic indicators of the actual situation.

When standards are changed, it is necessary to revalue inventories. Generally, it is desirable to cost out the inventories at both the old and new standards, so that the gain or loss from revision of standards is not buried in the variance accounts. This difference is charged to a special account called *Gain or Loss from Revision of Standards*.

### Chapter supplement: statistical control charts and variance analysis

During recent years, statistics has begun to have an important influence on the collection and analysis of accounting data.<sup>1</sup> In particular, applications of sampling theory in accounting have enormously increased. Sampling techniques are being successfully employed in such areas as error detection, counting and pricing inventories, checking on the accuracy of perpetual inventory records, aging and confirmation of receivables, intercompany billings (airlines), condition of fixed assets (telephone poles), cost determination, and verification of internal control.

Statistical sampling is based on the occurrence of random, or chance, data. Although the distribution of data may adhere to other patterns—e.g., binomial, Poisson—applications of sampling theory largely are based on a *normal, or bell-shaped, distribution*, which is very common. Two important characteristics of the data (observations) are their central tendency and their dispersion. The more disperse, or scattered, the data, the less representative the mean of the sample data is of the entire population. Dispersion may be measured in several ways, including (1) range ( $R$ ), which is the magnitude of variation between the highest and lowest values, (2) the average deviation  $(X - \bar{X})/n$ , which is the average of the deviations of the individual items from their mean, and (3) standard deviation

$$\sqrt{\sum \frac{(X - \bar{X})^2}{n}}$$

<sup>1</sup> See Robert M. Trueblood and Richard M. Cyert, *Sampling Techniques in Accounting* (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1957), and Lawrence L. Vance and John Neter, *Statistical Sampling for Auditors and Accountants* (New York: John Wiley & Sons, Inc., 1956).



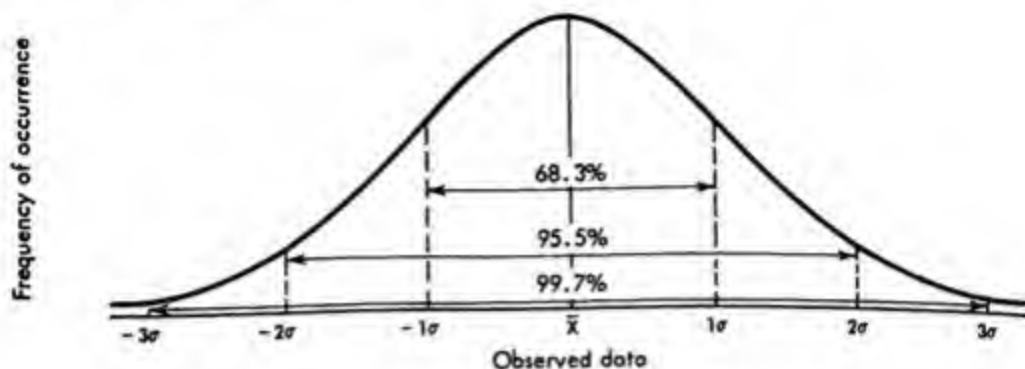


Fig. 10-1 Normal distribution of random data.

which is the square root of the sum of the squares of the deviation from the mean divided by the number of values. The standard deviation is most commonly used in probability studies, since it generally provides the most precise measurement of dispersion.

In a normal, or bell-shaped distribution, the mean of the values ( $\bar{X}$ )  $\pm 1$  standard deviation ( $\sigma$ ) includes 68.3 percent of the values. The mean  $\pm 2$  standard deviations includes 95.5 percent of all values, and the mean  $\pm 3$  standard deviations includes 99.7 percent of all values. This means that in a normal distribution 997 out of 1,000 of the data will be found within the boundaries of the mean  $\pm 3$  standard deviations. This is shown in Fig. 10-1.

In standard cost systems, a difficulty that presents itself is determining when a variance is significant. It might be argued that if the standard represents a level of good attainable performance, all deviations are meaningful. However, experience with actual cost data shows that the data will vary upward or downward (from the mean) and that most of these variations are inherent in the data; that is, the deviations are normal or occur for uncontrollable and probably unknown reasons. Failure to recognize this normal tendency results in efforts to explain inexplicable variances. It evokes frustration on the part of the cost accountant, factory managers, and laborers. Statistical control charts are most useful in overcoming this situation. They also generally will provide more precise data, more rapidly and at less cost.

Statistical control charts have their origin in statistical quality control charts, on which there exists an extensive literature.<sup>2</sup> The control chart defines the limits within which normal or chance occurrences take place. Data which fall beyond these boundaries may be assumed to be abnormal, i.e., to represent significant variations from the norm of the population. When the observed data fall outside of the control limits,

<sup>2</sup> See, for example, Eugene L. Grant, *Statistical Quality Control*, 3d ed. (New York: McGraw-Hill Book Company, 1964); William G. Cochran, *Sampling Techniques*, 2d ed. (New York, John Wiley & Sons, Inc., 1963); and William Edwards Deming, *Some Theory of Sampling* (New York: John Wiley & Sons, Inc., 1950).

## Exhibit 10-7

Data Supporting Statistical Control Chart  
Labor Cost per Unit

	Number of samples (weeks)									
	1	2	3	4	5	6	7	8	9	10
Number of items per sample	6.87	6.94	7.02	7.01	6.94	6.98	6.91	7.02	7.10	6.92
	7.09	7.12	6.92	7.12	7.11	7.16	6.84	7.10	6.94	6.90
	6.91	6.86	6.92	6.98	6.97	6.96	7.20	7.18	7.08	7.00
	6.90	7.14	7.06	6.86	6.88	7.04	6.96	6.84	6.81	7.01
	7.01	7.02	7.00	7.00	6.96	6.72	6.85	7.07	7.00	7.02
Total.....	34.78	35.08	34.92	34.97	34.86	34.86	34.76	35.21	34.93	34.85
Mean ( $\bar{X}$ ).....	6.96	7.02	6.98	6.99	6.97	6.97	6.95	7.04	6.99	6.97
Range ( $R$ ).....	.22	.28	.14	.26	.23	.44	.36	.34	.29	.12
Grand mean ( $\bar{\bar{X}}$ ).....	6.98									
Average range ( $\bar{R}$ ).....	.27									

the system is described as being out of control, and the causes require investigation. In establishing a control chart, the degree of precision desired must be specified. In the case of control charts for cost analysis, often 3 standard deviations are used, as will be the case in the illustration which follows.

In Exhibit 10-7, the actual labor cost of a product manufactured has been summarized for a 10-week period, each week containing 5 workdays or daily samples. The standard cost for the product is \$6.90. If the actual data in Exhibit 10-7 were plotted, a normal distribution would be achieved, as shown in Fig. 10-2. The more observations taken, the closer the mean of the sample would be to that of the entire population. The mean ( $\bar{X}$ ) for each week is calculated by totaling the cost for each week and dividing by the number of samples (e.g., first week 34.78/5). The range ( $R$ ) represents the magnitude of the difference between the highest and lowest values in the sample (e.g., first week 7.09 - 6.87). The average of the means ( $\bar{\bar{X}}$ ) and the average of the range ( $\bar{R}$ ) is calculated in a similar fashion. The control limits are reflected in the following equations:

$$\text{Upper control limit (UCL)} = \bar{\bar{X}} + A_2\bar{R}$$

$$\text{Lower control limit (LCL)} = \bar{\bar{X}} - A_2\bar{R}$$

The values of  $\bar{\bar{X}}$  and  $\bar{R}$  are 6.98 and .27 respectively, i.e., for the data in Exhibit 10-7. By referring to Exhibit 10-8, we can determine the value for  $A_2$ . This is done by comparing the  $A_2$  column with the  $n$  column for

Frequency of occurrence

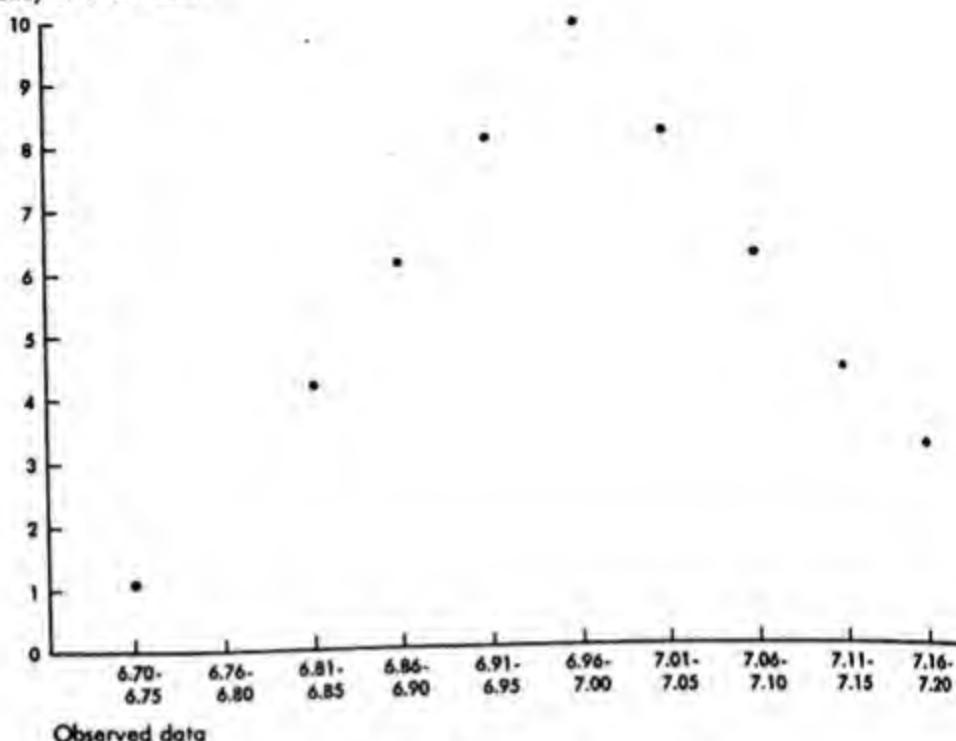


Fig. 10-2 Distribution of samples of labor cost per unit.

five samples, or observation subgroups.  $A_2$  thus equals .58. Substituting in the formula, we now obtain the following control limits for our data:

$$UCL = 6.98 + (.58)(.27), \text{ or } 7.14$$

$$LCL = 6.98 - (.58)(.27), \text{ or } 6.82$$

The control chart now appears as shown in Fig. 10-3. To repeat, as long as the data fall within the control limits, they will be due to chance

Labor cost per unit

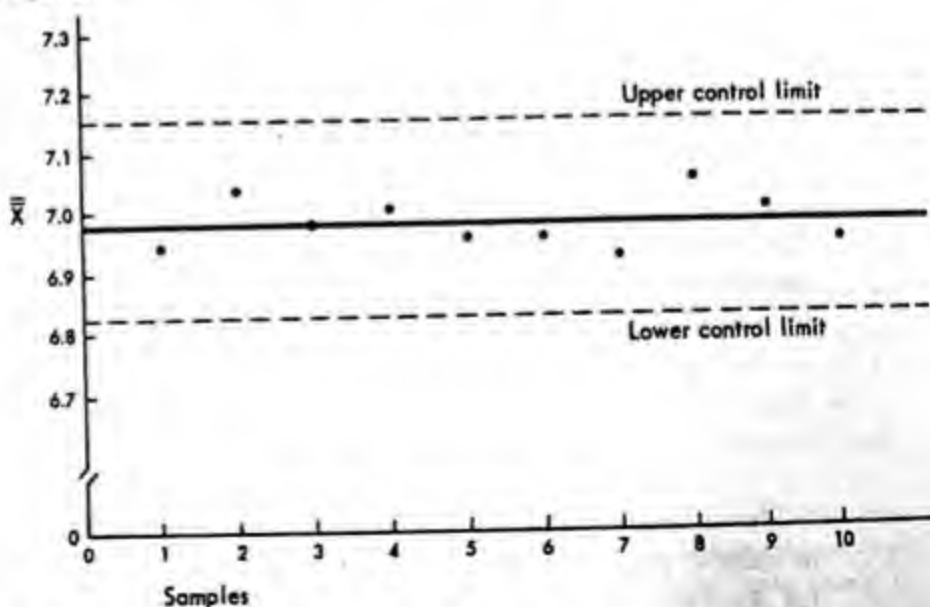


Fig. 10-3 Control chart for samples of labor cost per unit.

Exhibit 10-8

Factors for Determining from  $\bar{R}$  the 3-standard-deviation Control Limits for  $\bar{X}$ \* and  $R$  Charts

$n$ , number of observations in subgroup	$A_2$ , factor for $\bar{X}$ chart	Factors for $R$ chart	
		$D_3$ , lower control limit	$D_4$ , upper control limit
2	1.88	0	3.27
3	1.02	0	2.57
4	0.73	0	2.28
5	0.58	0	2.11
6	0.48	0	2.00
7	0.42	0.08	1.92
8	0.37	0.14	1.86
9	0.34	0.18	1.82
10	0.31	0.22	1.78
11	0.29	0.26	1.74
12	0.27	0.28	1.72
13	0.25	0.31	1.69
14	0.24	0.33	1.67
15	0.22	0.35	1.65
16	0.21	0.36	1.64
17	0.20	0.38	1.62
18	0.19	0.39	1.61
19	0.19	0.40	1.60
20	0.18	0.41	1.59

\* Upper control limit for  $\bar{X} = UCL_{\bar{X}} = \bar{\bar{X}} + A_2\bar{R}$ .

Lower control limit for  $\bar{X} = LCL_{\bar{X}} = \bar{\bar{X}} - A_2\bar{R}$ .

999 times out of 1,000 and can be ignored. The only exception to this is if the data, while still remaining within the control limits, follow a continuous trend in one direction. This should be investigated, as should all data falling outside the control limits.

It will be noted that two columns in Exhibit 10-8 were not used ( $D_3$  and  $D_4$ ). These columns are used if a separate control chart also is prepared for range. Since the sample data rarely exceed the original range, range control charts are not commonly used in variance analysis.

Control charts are of great value in variance analysis. However, caution must be exercised. Their value diminishes when standards are not consistent (equally tight or loose for all products). It also should be emphasized that the fact that the data fall within the control limits does not imply that the operation is being performed at maximum efficiency.

## Problems and cases

- 10-1 *Measures of capacity and business purpose.* Explain fully the various measures of production capacity and the influence of each upon costs developed for these management purposes:
1. Product costing and pricing
  2. Cost control
  3. Plant shutdown
- 10-2 *Costs and motivation.* Discuss the role of accounting measurements in the motivation and control of employees and lower-level supervisory personnel.
- 10-3 *Idle-facilities cost.* Indicate how the cost of idle facilities should be accounted for with respect to the firm's profit seeking objectives, the nation's welfare, and economic activity internationally.
- 10-4 *Nonproductive labor time.* Comment on the possible ways of taking into consideration in standard costing nonproductive labor time, such as "personal" time required by law or the union contract and "down" time caused by the breakdown of machines. Indicate how such factors might affect the setting of standard costs, the analysis of variances, and corrective action resulting from the analysis and interpretation of variances.
- 10-5 *Effect of averaging in cost accounting.* In setting standards and establishing standard costs, there is a considerable amount of averaging. For example, processing time in an operation may vary with the particular machine used; yet a standard time which is an average time ordinarily is developed and used. Mention other factors for which averages might be used, and discuss the importance of this averaging in the analysis of variances and the use of standard costs for control purposes and for product costing and planning purposes.
- 10-6 *Standard costs and job-order systems.* Explain how standard costs developed in a job-order method of production may be useful at a later time if the firm changes to a continuous process arrangement.
- 10-7 *Materials shrinkage and loss.* In establishing standard costs, how might the shrinkage and loss of materials be taken into consideration?
- 10-8 *Physical standards and dollar standards.* What merits are there in using physical measures of materials and labor rather than dollar measures in controlling an operation? Are these same measures useful and sufficient for product-costing purposes?
- 10-9 *Standard costs and the accounting system.* Describe how standards and standard costs might be developed and used without incorporating such data into the formal accounting system.
- 10-10 *Change in standards.* Standard costs and their underlying standards frequently are adjusted for factors which are considered to be uncontrollable by various levels of management. Suggest some types of factors for which useful information can be obtained by not changing the standard but by reflecting the factor as a variance.



- 10-11 *Standard product costs and standard operations costs.* Discuss the interrelationship between standard costs developed for products and standard costs developed for production operation.
- 10-12 *Automation and standard costs.* Describe how the increased use of automation in a particular factory may affect the establishment and use of standard costs in controlling operations.
- 10-13 *Standard costs and free enterprise.* Are standard costs and their use peculiar to a free-enterprise economy, or are they useful also in a noncompetitive environment? Are there any particular industries in which you feel that standard costs would be of little, if any, use?
- 10-14 *Success of standard cost systems.* Mention some factors which might contribute to the failure of a standard cost system to be utilized effectively.
- 10-15 *Standard cost card.* Describe the function of a standard cost card.
- 10-16 *Standard materials cost calculation.* The manufacture of Binos requires three units of material R at a standard cost of \$2.20 per unit. During 1 week, 400 units of Binos were produced, and 830 units of material R were consumed in this production. Calculate:
1. The standard materials cost per unit of Binos
  2. The total standard cost of materials for Binos for the week
  3. The cost of materials used in excess of standard
- 10-17 *Standard labor cost calculation.* The Garcia Company has determined that during a particular month of average length 4,400 units of Otop could be produced. Based on a study, an average of 20 out of an average of 200 man-hours per week is lost for various reasons. The five production employees work an average of 40 hours per week. Total payroll cost paid on a weekly salary basis amounts to about \$1,600 per month. Indicate how each of these items of information might influence the development of a standard labor cost per unit of Otop produced.
- 10-18 *Appraisal of standard cost usage.* The Torres Company has divided its factory into four processes or cost centers. The use of each of these processes is required to manufacture product Oho out of material Beta. The firm also manufactures other products, but not all of them require all the processes. Each process has been assigned a standard operating cost per hour for labor and factory overhead amounting to \$28. Discuss the usefulness of the standard-costing system for control purposes and for the costing of product Oho.
- 10-19 *Effect of capacity measurement on make or buy decisions.* The Silva Company manufactures parts and assembles them into a single major finished product. Slight variations in the design and complexity of the finished product are made to produce different styles, which are marketed at different prices. Some of the parts which are used in the assembly of the product are quite standard, since there are several other companies which manufacture them and supply them to the industry.

The management recently established the policy that the Silva Company should manufacture the parts when it is more economical to do so and should purchase them from outside suppliers, if available, when the purchase price is at least 5 percent lower than the Silva Company's cost to manufacture.

In implementing this policy, the controller of Silva realized that the cost of manufacture would depend upon the particular measure of capacity used in calculating the factory-overhead rate. He felt that two particular measures of capacity were significant, practical capacity and normal capacity. Practical capacity was defined as the theoretical maximum capacity of the firm minus certain unavoidable inefficiencies over which essentially there was no control. Normal capacity was defined as the average capacity experienced by the firm over the past 2 years. The factory-overhead rate for the current year on a practical capacity basis would amount to \$9 per direct-labor hour, whereas on a normal capacity basis it would be \$14 per direct-labor hour. The firm was currently operating at 80 percent of practical capacity and in past years had operated at from 45 to 90 percent of practical capacity.

The controller proposed the following rule with respect to decisions to make or to buy the component parts: "In determining manufactured cost, the practical-capacity factory-overhead rate should be used when the firm is operating at 75 percent of practical capacity or above; the normal-capacity factory-overhead rate should be used when the firm is operating at less than 75 percent but more than 50 percent of capacity. In addition, when the firm is operating at 50 percent of capacity or less, factory overhead should be excluded entirely from the calculation of the manufactured cost."

Appraise the rule developed by the controller, and discuss any modifications you might want to make.

- 10-20 *Capacity measurement and acceptance of orders.* The Avada Company wanted to stabilize its production at approximately 90 percent of practical capacity and also was not interested in expanding beyond its present size. The company was in a position to select which orders it wished because of its reputation for quality and its long-established tradition of reliability. In recent years, the company had operated at 75 to 95 percent of practical capacity.

In order that stability might be achieved, the following policy was proposed by the controller: "When the firm is operating at 75 to 85 percent of practical capacity, no order should be accepted which does not cover the direct costs of materials and labor plus 50 percent of these prime costs. When the firm is operating at 86 percent of practical capacity or above, no order should be accepted which does not cover the direct costs of materials and labor plus 30 percent of these prime costs."

The controller explained that as the firm approached practical capacity it should not demand so much profit in quoting prices for potential orders. He stated that "even the 30 percent was 'pure gravy' because factory-overhead costs are covered whenever the firm was operating at 85 percent of practical capacity."

1. What do you think of the controller's suggestion and of his reasoning to support it?
2. If you were to modify his proposal, what additional information would you want?

- 10-21 *Meaning of variances.* Explain the general distinction between a price or rate variance and a quantity or efficiency variance.

- 10-22 *Overhead efficiency variance.* Many firms fail to calculate the overhead efficiency variance. What is the meaning of this variance? Are firms justified in not calculating it?

**10-23** *Random variances.* Production supervisor to cost accountant: "Frequently, I go out to find the cause of unfavorable labor efficiency and materials utilization variances and can find no explanation for them." Can you suggest a method to assist the supervisor?

**10-24** *Preparation of standard cost sheet.* A new product of Elise Toiletries, Inc., is Lano-Lov skin lotion, to be sold in 4-ounce bottles at a suggested retail price of \$1. Cost and production studies show the following cost:

Container			
Item no.	Description	Cost	Comments
2147	4-oz bottle	\$5.50 per gross	Allow for waste and breakage—2%
315	Label	3.30 per 1,000	Allow for waste and breakage—3%

(Product will be reshipped in bottle cases.)

Raw Materials			
Item no.	Description	Cost	Quantity used per 125-gal batch, lb
4247	Compound 34A	\$40 per 100 lb	70.0
3126	Alcohol and glycerin	40 per 100 lb	76.0
4136B	Perfume oil*		3.5

\* Perfume oil is mixed by the company according to its secret formula.

Standard costs of a 90-pound batch are as follows:

Ingredients.....	\$2,169.95
Direct labor—4.4 hr @ \$2.28 per hr.....	10.03
Manufacturing overhead—\$7.50 per batch plus \$1.95 per standard labor hr	

(Note: A gallon contains 128 oz.)

#### Allowance for Lost Material

Overfilling, waste, and breakage—Allow 4% of standard materials cost

#### Direct Labor per Gross

Compounding.....	0.12 hr at \$1.90
Filling and packing.....	1.00 hr at \$1.60

#### Manufacturing Overhead

Compounding.....	\$3.00 per standard labor hr
Filling and packing.....	1.50 per standard labor hr plus .90 per gross

You are to prepare a standard cost sheet for one gross bottles of this product, arranging the data under the five subheadings listed above. Calculations should be made to the nearest cent per gross.

(AICPA)

**10-25** *Calculation of standard cost variances.* The Fairbanks Company uses a standard cost system. Inventories on hand at the beginning of the month, priced at standard, are as follows:

Raw material A, 6,000 units.....	\$ 3,000
Raw material B, 7,000 units.....	11,200
Total.....	<u>\$14,200</u>
In process.....	-0-
Finished goods.....	\$43,500

The standard cost card for the single product manufactured by the company is shown below:

	Dept. 1	Dept. 2
Raw materials:		
A, 8 units @ \$.50.....	\$ 4	
B, 20 units @ \$1.60.....	32	
Direct labor:		
4 hr @ \$3.....	12	
2 hr @ \$4.....		\$ 8
Overhead:		
Variable, \$1 per hr.....	4	
Fixed, \$3 per hr.....	12	
Variable, \$1.50 per hr.....		3
Fixed, \$4 per hr.....		8
Total department cost.....	<u>\$64</u>	<u>\$19</u>
Dept. 1 cost.....		64
Total product cost.....		<u>\$83</u>

The budgeted monthly fixed overhead for Department 1 is \$24,000 and for Department 2 is \$14,000.

Purchases during the month were: raw material A, \$13,720 (28,000 units); raw material B, \$97,200 (60,000 units); supplies, \$4,500. During the month 2,000 of the units purchased of raw material A were found to be defective and were returned to the supplier.

Units completed and transferred during the month were 1,600 in each department. Two thousand units were in process in Department 1 at the end of the month and were 50 percent complete as to labor and overhead. No units were lost in process.

Payroll accrued for producing departments during the month was: Department 1, \$27,600 (\$2,800 indirect); Department 2, \$16,865 (\$3,500 indirect).

Supplies used were: Department 1, \$1,500; Department 2, \$1,200. Other direct overhead charges were: Department 1, \$9,500; Department 2, \$6,300.

General-plant overhead is billed to producing departments at \$2 per actual hour worked. Actual direct-labor hours worked in Department 1 were 8,000; in Department 2 there were 3,300.

Since only two materials are used, the company finds it easier to control inventories by making a physical count at the end of the month instead of using a requisitioning system. At the end of the current month, there were



15,000 units of A and 29,000 units of B in stock. Finished goods on hand (at standard) amounted to \$26,100.

*Required:*

1. The raw materials price variance (calculated on the basis of purchases) was \_\_\_\_\_.
2. The raw materials utilization variance was \_\_\_\_\_.
3. The direct-labor rate variance in Department 1 was \_\_\_\_\_.
4. The direct-labor rate variance in Department 2 was \_\_\_\_\_.
5. The labor efficiency variance in Department 1 was \_\_\_\_\_.
6. The labor efficiency variance in Department 2 was \_\_\_\_\_.
7. The overhead budget variance (overhead applied on basis of standard hours) in Department 1 was \_\_\_\_\_.
8. The overhead budget variance in Department 2 was \_\_\_\_\_.
9. The overhead volume variance in Department 1 was \_\_\_\_\_.
10. The overhead volume variance in Department 2 was \_\_\_\_\_.
11. The charge to finished goods was \_\_\_\_\_.
12. The cost of sales for the month was \_\_\_\_\_.

**10-26** *Standard cost variance analysis.* Department 1 of the Baker Company manufactures product X. Because of the nature of production, a process cost system is used. Standard costs are integrated into the process cost accounts. The standard cost card for one unit of product X is as follows:

Raw material A, 1 lb at \$2 per lb.....	\$ 2.00
Raw material B, 2 lb at \$3 per lb.....	6.00
Direct labor, grade A, $\frac{1}{2}$ hr @ \$3.20 per hr.....	1.60
Direct labor, grade B, 2 hr @ \$2.10 per hr.....	4.20
Departmental overhead (based on grade B labor hr):	
2 hr @ \$3.60.....	7.20
Total standard cost per unit of product X.....	<u>\$21.00</u>

Material A is added at the beginning of processing in Department 1, and Material B is added at the very end of processing in Department 2. Two grades of direct labor are used, grade A and grade B, and each is assumed to be added uniformly throughout processing.

Departmental overhead includes overhead items which are direct with respect to the department and also overhead items which have been allocated to the department from service departments and from the general factory as a whole. Materials price variance is separated out of the cost accounts at the time materials are purchased.

The annual departmental overhead budget for Department 1 is as follows, based on an annual capacity of 100,000 grade B labor hours:

Variable overhead.....	\$ 60,000
Fixed overhead.....	300,000
Total.....	<u>\$360,000</u>

The Baker Company adjusts variable overhead for the actual activity level achieved in the month; fixed overhead in the adjusted budget represents one-twelfth of the annual fixed-overhead budget dollar amount.

Actual production data for Department 1 for the month of May are as follows:



Work in Process Inventory, May 1:

600 actual units of product X (in terms of finished product), all of which were  $\frac{1}{5}$  finished as of May 1 (at standard cost)..... \$3,800

Raw material A consumed in production, 4,600 lb

Raw material B consumed in production, 8,200 lb

Actual direct-labor hours worked, grade A, 2,025 hr @ \$3.20 actual rate

Actual direct-labor hours worked, grade B, 8,200 hr @ \$2.10 actual rate

Units of product X completed and sent to finished goods, 4,000

Work in Process Inventory, May 31:

1,000 actual units of product X (in terms of finished product), all of which were one-fourth finished as of May 31 (at standard cost)..... \$ 3

Actual overhead incurred in May, Dept. 1:

Variable .....	\$ 7,000
Fixed .....	25,000
Total .....	<u>\$32,000</u>

*Required:* You are to compute the following:

1. Variable-overhead adjusted budget allowance for May
2. Fixed-overhead adjusted budget allowance for May
3. Materials usage variance, material A
4. Materials usage variance, material B
5. Labor rate variance, grade A labor
6. Labor rate variance, grade B labor
7. Labor efficiency variance, grade A labor
8. Labor efficiency variance, grade B labor
9. Overhead budget or spending variance
10. Overhead efficiency variance
11. Overhead volume variance
12. Standard cost of goods manufactured
13. Standard cost of Work in Process Inventory, May 31

**10-27** The Jones Furniture Company uses a standard cost system in accounting for its production costs.

The standard cost of a unit of furniture follows:

Lumber, 100 ft @ \$150 per 1,000 ft.....	\$15
Direct labor, 4 hr @ \$2.50 per hr.....	10
Manufacturing overhead:	
Fixed (30% of direct labor).....	\$3
Variable (60% of direct labor).....	<u>6</u>
Total unit cost.....	<u>\$9</u>
	<u>\$34</u>

The following flexible monthly overhead budget is in effect:

<i>Direct-labor hr</i>	<i>Estimated overhead</i>
5,200 .....	\$10,800
4,800 .....	10,200
4,400 .....	9,600
4,000 (normal capacity).....	9,000
3,600 .....	8,400

The actual unit costs for the month of December were as follows:

Lumber used (110 ft @ \$120 per 1,000 ft).....	\$13.20
Direct labor (4¼ hr @ \$2.60 per hr).....	11.05
Manufacturing overhead (\$10,560 ÷ 1,200 units).....	8.80
Total actual unit cost.....	<u>\$33.05</u>

*Required:* Prepare an exhibit which shows an analysis of each element of the total variance from standard cost for the month of December.

(AICPA)

## 11. **Standard Cost Accounting— Recording and Reporting**

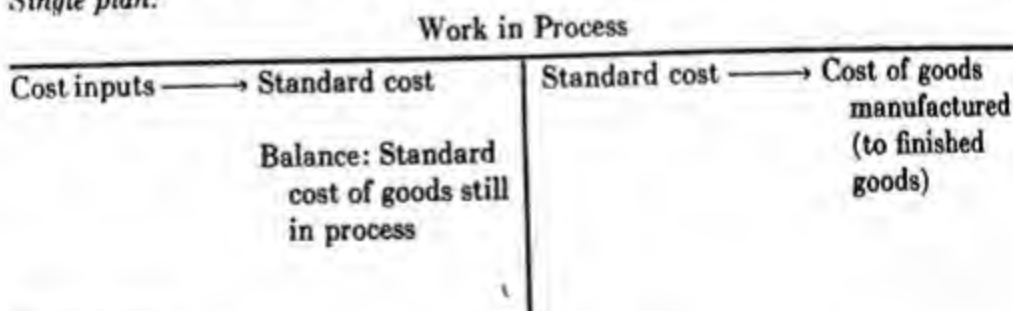
Several different types of standard cost accounting systems are found in practice. In general, however, they either conform to or are variations of two basic patterns, commonly referred to as the *single plan* and the *partial plan*. Under the single plan, variances are recognized on the basis of cost *inputs*, i.e., as factory costs are incurred. Hence, all charges and credits to Work in Process are made at standard cost.

Under the partial plan, charges to Work in Process are made at actual cost, and credits are made at standard cost. Variances are determined on the basis of *output*. The variances remain in the balance of the Work in Process account until adjusted by means of a physical inventory. The

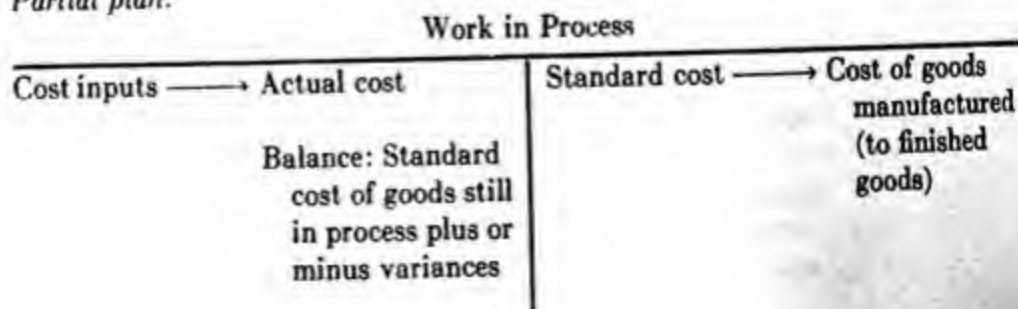
### *Exhibit 11-1*

#### Cost Flows under the Single and Partial Plans

##### *Single plan:*



##### *Partial plan:*





## Exhibit 11-3

THE JOHNSON COMPANY  
Cost Accounts, January 1  
Trial Balance

	Debit	Credit
Material R inventory, 1,000 @ \$.30.....	\$300	
Material S inventory, 3,000 @ \$.18.....	540	
Direct-labor payroll.....	—0—	
Factory-overhead control.....	—0—	
Work in process.....	—0—	
Finished goods.....	—0—	
Cost of goods sold.....	—0—	
Other accounts.....		\$840
	<u>\$840</u>	<u>\$840</u>

In Exhibit 11-4, the firm's *planning budget* for the year, based on production of 12,000 units of product (which is equal to 12,000 estimated grade A direct-labor hours), shows estimated production costs which the firm expects to incur in the factory. An annual output of 12,000 units of product is also the firm's practical capacity.

It should be noted that the Johnson Company does not use standard cost for materials in its annual planning budget for production activities, because the firm anticipates that there will be some variances. This is evident from a comparison of the budgeted unit cost of \$6.66⅔ and the

## Exhibit 11-4

THE JOHNSON COMPANY  
Production Budget—Annual  
12,000 Boxes of Zilch

	Total	Per output unit
Materials used—R.....	\$ 80,000	\$ 6.66⅔
Materials used—S.....	2,160	.18
Direct labor—Grade A (12,000 hr).....	30,000	2.50
Direct labor—Grade B (6,000 hr).....	12,000	1.00
Factory overhead:		
Variable:		
Indirect materials.....	\$ 2,000	.16⅔
Supervisory salaries.....	15,000	1.25
Repairs—machinery.....	1,000	.08⅓
	<u>18,000</u>	<u>1.50</u>
Fixed:		
Depreciation—machinery.....	\$ 8,000	
Depreciation—plant.....	9,000	
Other fixed.....	1,000	
	<u>18,000</u>	<u>1.50</u>
Total production budget.....	<u>\$160,160</u>	<u>\$13.34⅓</u>



standard cost of \$6.60 for material R. The budget contains estimates of what the firm thinks the actual incurred costs *will be*, whereas the standard cost indicates what the costs *should be*. In this case, the budget anticipates that actual shrinkage will exceed the 10 percent allowed in the standard for material R.

The standard factory-overhead rate of \$3 per direct-labor hour found on the standard product cost card is obtained from the annual production budget, i.e., estimated factory overhead of \$36,000 ÷ 12,000 estimated grade A direct-labor hours. The \$3 rate is made up of \$1.50 variable and \$1.50 fixed factory overhead.

Production data for the month are as follows:

Units of product completed: 800 boxes of Zilch.

Units of product in process, end of month: 4,004 pounds of material R, one-half processed. (This is the weight before normal shrinkage. It is estimated that this batch will amount to 182 boxes of Zilch when finished.)

Material R put into production: 22,000 pounds (gross weight before shrinkage).

Material R purchased: 23,000 pounds at 30 cents.

Material R spoiled: 396 pounds (no salvage value).

Material S used: 800 units.

### Accounting for raw materials

Weekly summaries of materials sent into production provide the basis for making the cost accounting entry to charge Work in Process, to separate out the materials quantity variance, and to credit the materials inventories. The materials price variance is separated out at the time of the purchase of materials. The variance is determined by comparing the standard cost of the shipment with the invoice cost. At this time the cost of freight, storage, and receiving are calculated also. These costs are not included in the materials cost; i.e., they are treated as period expenses.

The January entries to record the purchase and usage of materials are shown as entry 1 and entry 2, respectively. No material S was purchased during the month. Purchased raw materials do not, of course, become costs of production until they are *used* in production.

(1)	
Raw Materials Inventory—R (23,000 lb @ .30) ..	6,900
Material Price Variance .....	-0-
Accounts Payable .....	6,900
(2)	
Work in Process .....	6,625
Materials Quantity Variance .....	119
Raw Materials Inventory—R .....	6,600
Raw Materials Inventory—S .....	144

The 800 finished units should have required 17,600 pounds of material R ( $800 \times 22$  pounds). The 182 units still being processed should require 4,004 pounds of material R, which is added at the beginning of processing ( $182 \times 22$  pounds). The standard materials cost for starting and finishing 800 units and doing half the processing of the 182 output units in the ending work-in-process inventory (which is complete with respect to material R) amounts to 21,604 pounds  $\times$  \$.30, or \$6,481 (rounded). Each unit of the 800 finished requires 1 unit of packaging, costing 18 cents standard, or \$144.

The standard materials cost is set at 30 and 18 cents per pound for materials R and S, respectively. These are also the current actual unit prices. At the present time there is no price variance. Any change in the supplier's price would result in a price variance. For example, assume that the actual cost of the 23,000 unit of R purchased was 32 cents per unit instead of 30 cents. The entry to separate out the price variance would be:

Raw Materials Inventory—R.....	6,900	
Materials Price Variance.....	460	
Accounts Payable.....		7,360

Determination of this variance is useful to management for reasons other than control. A price variance may help to explain a failure to reach a planned profit objective, and may lead to a change in product design, quality, or price.

### Exhibit 11-5

#### THE JOHNSON COMPANY Materials Quantity Variance Report

	Quantity	Standard Cost
Material put into production.....	22,000 lb mat. R	\$6,600
Standard materials allowance for production accomplished.....	21,604 lb mat. R	6,481
Variance (per attached pink slips).....	396 lb mat. R	\$ 119
Variance anticipated in budget.....	982 units of out-put @ \$.06 $\frac{2}{3}$	65
Excess of variance over budget allowance...		\$ 54
Reasons for total variance:		
<input checked="" type="checkbox"/> Spoilage		
_____ Inferior quality of materials		
_____ Other (explain):		

Action taken to correct situation:  
Machine repaired

Production Manager

*Exhibit 11-6*THE JOHNSON COMPANY  
Spoilage Report

Production date: Month of January      Type of material: R  
Amount of spoilage: 396 lb      Percent of material used: 1.8 %  
Approximate stage of completion: Not started (spoiled at start)  
Cause of spoilage: Materials damaged by faulty machine operation at beginning of process  
Corrective action taken: Machine repaired  
Disposition of spoiled materials (salvaged or discarded): Discarded

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Production Manager

Each evening at the Johnson Company, the standard quantity of materials is requisitioned and issued for the production scheduled for the following day. As production takes place, if additional materials are needed to replace those spoiled in production, an identical requisition, printed on paper of a different color (pink), is used to support the issuance of the excess materials required. These pink slips are the basis for the materials quantity variance report prepared daily. This report is prepared in the production department and sent to the production manager. A summary of materials variances for the week and month is prepared for the plant manager, as shown in Exhibit 11-5.

Exhibit 11-6 is the spoilage report which is prepared daily for production management, when necessary, for all spoiled raw materials or partially processed product. This report ties in with the materials quantity variance report. Weekly and monthly summary reports also are prepared for the plant manager.

The 2-pound material shrinkage per box (10 percent of 20 pounds) is normal (see Exhibit 11-2) and is not considered to be spoilage. The standards are set so that this normal shrinkage increases the materials cost per case of output from \$6 to \$6.60. Spoilage (other than the normal shrinkage) which is not salvaged is included in the materials quantity variance. In January, 396 pounds of raw material R were spoiled. No spoilage was salvaged in January.

**Accounting for direct labor**

Direct-labor costs incurred, according to payroll summaries, during the month of January amounted to \$2,750 for grade A employees and \$1,100 for grade B employees. Actual rates are the same as the standard rates set by union contract, \$2.50 and \$2 per hour, respectively. In January grade A labor worked 1,100 hours, and grade B worked 550 hours (entry 3).

(3)

(Direct Labor Payroll is debited and credits are made to Cash and various liabilities for withheld taxes, etc., for the total of \$3,850. Direct-labor costs flow into the Work in Process account as a result of entry 4.)

(4)

Work in Process—Direct Labor.....	3,118.50	
Labor Efficiency Variance—Grade A.....	522.50	
Labor Efficiency Variance—Grade B.....	209.00	
Direct Labor Payroll.....		3,850

Equivalent units of output completed in January amount to 891 (i.e.,  $800 + \text{one-half of the } 182 \text{ units still in process}$ ). Grade A direct-labor hours which should have been incurred amount to 891 (i.e.,  $891 \text{ units of output} \times 1 \text{ grade A direct-labor hour per output unit}$ ). Standard grade B direct-labor hours amount to  $445\frac{1}{2}$  hours ( $891 \text{ units of output} \times \frac{1}{2} \text{ grade B direct-labor hour per unit of output}$ ). The standard direct-labor cost amounts to \$3,118.50 (i.e.,  $891 \text{ hours of grade A} \times \$2.50 + 445\frac{1}{2} \text{ hours of grade B} \times \$2$ ).

The difference between the standard direct labor charged to the Work in Process account and the actual direct labor credited to the Direct Labor Payroll account is the total of the *labor efficiency variance* for the two classes of direct labor. The Johnson Company follows the practice of charging or crediting the Labor Efficiency Variance accounts as the payroll is distributed (entry 4).

In order to produce January's output, 891 hours of grade A direct labor should have been used rather than the 1,100 actual hours. The 209 inefficient hours multiplied by the standard rate per hour of \$2.50 equals \$522.50, the grade A labor efficiency variance. Standard grade B direct-labor hours amounts to  $445\frac{1}{2}$ . Actual grade B direct-labor hours worked was 550. The  $104\frac{1}{2}$  inefficient hours at a standard cost of \$2 each equals \$209, the grade B labor efficiency variance. Since no labor rate variance or price variance is assumed or calculated in this case, the labor efficiency variances can be calculated more easily in the following way:

- Grade A direct labor: 891 equivalent units produced multiplied by \$2.50 standard direct-labor cost per unit of output equals \$2,227.50. Actual labor cost incurred, \$2,750, minus standard labor cost, \$2,227.50, equals \$522.50 grade A direct-labor efficiency variance.
- Grade B direct labor: 891 equivalent units produced multiplied by \$1 standard direct labor cost per unit of output equals \$891. Actual labor cost incurred, \$1,100, minus standard labor cost, \$891, equals \$209 grade B direct-labor efficiency variance.

To show how entry 4 would appear if there were a labor rate variance, assume that the actual rate for grade A labor was \$2.70 and the standard rate was \$2.50. Entry 4 would be:



Work in Process—Direct Labor .....	3,118.50	
Labor Rate Variance—Grade A .....	220.00	
Labor Efficiency Variance—Grade A .....	522.50	
Labor Efficiency Variance—Grade B .....	209.00*	
Direct Labor Payroll .....		4,070.00

\* Rounded.

The labor efficiency report in Exhibit 11-7 is prepared for control purposes daily. Because the in-process inventories tend to be the same at the beginning and end of each day, the actual labor hours and costs incurred each day can be compared with the standard labor hours and costs for the units of product *completed* each day. When there is a significant change in the work-in-process inventory, this is taken into consideration in the analysis of direct-labor efficiency variances through the use of the equivalent units measure of production. Weekly and monthly summary reports on the direct-labor efficiency variance also are prepared for management information.

### Accounting for factory overhead

The actual factory overhead incurred during January amounted to \$3,800, of which \$1,700 was variable and \$2,100 was fixed. The actual variable overhead consisted of indirect materials amounting to \$196, supervisory salaries, \$1,320, and repairs to machinery, \$184. Entry 5 records the incurrence of the actual factory overhead. Credits are made to such accounts as cash, accounts payable, accrued liabilities, prepaid assets, and allowance for depreciation.

(5)

Factory Overhead Control .....	3,800	
Various Accounts .....		3,800

Factory overhead is applied to production at the close of each month. At the end of January, standard overhead amounting to \$2,673 was ap-

### Exhibit 11-7

#### THE JOHNSON COMPANY

#### Direct Labor Efficiency Report

(Using summary data for the month of January)

Equivalent production 891

	Grade A labor		Grade B labor	
	Hours	Cost	Hours	Cost
Standard direct-labor hour allowance ..	891	\$2,227.50	445½	\$ 891
Actual direct-labor hours worked .....	1,100	2,750.00	550	1,100
Variance (no allowance for this variance was included in the budget) ..	209	522.50	104½	209
Efficiency, % (standard ÷ actual) ..	81%		81%	

Reasons for variance: New production personnel

Corrective action taken:

Production Manager



plied to production. This is derived by multiplying the standard hours of grade A labor (891) by the standard factory-overhead rate (\$3). Entry 6 records the application of factory overhead to production.

(6)	
Work in Process.....	2,673
Factory Overhead Applied.....	2,673

The Factory Overhead Control account and the Factory Overhead Applied account are closed out each month and the overhead variances separated out. The Johnson Company uses the two-variance method of overhead analysis discussed in Chapter 10.

Prior to determining these two variances, it is necessary to develop *adjusted budgetary data* based on the standard hours worked in January. The practical capacity for the month is determined, in terms of output potential, to be approximately 1,400 units of output. The fixed factory overhead assignable to January's adjusted budget amounts to  $1,400/12,000$  of the annual budget of \$18,000, or \$2,100. The variable factory-overhead allowance in January amounts to \$1,336.50 (i.e.,  $\$1.50 \times 891$  standard hours). The total adjusted budget is equal to \$3,436.50, as shown in Exhibit 11-8.

Entry 7 sets up the two variance accounts and closes out the Factory Overhead Control account and Factory Overhead Applied account. The unfavorable budget variance of \$363.50 is the difference between the actual overhead (\$3,800) and the adjusted budget (\$3,436.50). The unfavorable volume variance, which amounts to \$763.50, is the difference between the factory overhead applied to production (\$2,673) and the adjusted budget (\$3,436.50).

(7)	
Factory Overhead Applied.....	2,673.00
Overhead Budget Variance.....	363.50
Overhead Volume Variance.....	763.50
Factory Overhead Control.....	3,800

An overhead control report is issued monthly which compares the actual overhead costs incurred with the budget allowances. The report for the month of January for the Johnson Company is presented in Exhibit 11-9.

#### Exhibit 11-8

#### THE JOHNSON COMPANY Adjusted Factory Overhead Budget For the Month of January

Variable factory overhead: 891 standard hours (grade A labor)	
$\times \$1.50$ .....	\$1,336.50
Fixed factory overhead: (January practical capacity, 1,400 $\div$ annual practical capacity, 12,000 $\times$ annual budgeted fixed factory overhead, \$18,000).....	2,100.00
Total adjusted budget.....	\$3,436.50

## Exhibit 11-9

**THE JOHNSON COMPANY**  
Overhead Control Report  
Month of January

Overhead costs	Adjusted budget allowances (891 standard hr)		Actual cost	Budget variance
	Per unit	Total		
Indirect materials.....	\$ .16 $\frac{2}{3}$	\$ 148.50	\$ 196	\$ 47.50
Supervisory salaries.....	1.25	1,113.75	1,320	206.25
Repairs to machinery.....	.08 $\frac{1}{3}$	74.25	184	109.75
Total.....	\$1.50	\$1,336.50	\$1,700	\$363.50

Entry 8 relieves Work in Process of the standard cost of goods finished and transferred to finished goods. The balance of the Work in Process account is the standard cost of the ending work-in-process inventory. The standard cost of goods manufactured amounts to \$10,624 (i.e., 800 units  $\times$  \$13.28 standard cost per unit as shown on the standard product cost card).

	(8)	
Finished Goods.....	10,624	
Work in Process.....		10,624

The balance of \$1,793 in the Work in Process account can be double-checked by the following calculation of costs remaining in process at the end of the period:

Material R: 182 actual units of Zilch at \$6.60 standard material cost.....	\$1,201
Material S.....	-0-
Labor and Factory Overhead: 91 equivalent units of Zilch at \$6.50 standard conversion cost.....	592
Standard cost of ending work-in-process inventory.....	\$1,793

As Zilch is sold, Finished Goods is relieved of the standard cost of goods sold, and this amount is charged to Cost of Goods Sold. The entry to record the sale at selling price must also be made. Assuming that half of the period's production is sold for \$7,000, the entries to record the standard cost of goods sold are shown below:

	(9)	
Cost of Goods Sold.....	5,312	
Finished Goods.....		5,312
	(10)	
Accounts Receivable.....	7,000	
Sales.....		7,000

*Exhibit 11-10*

**THE JOHNSON COMPANY**  
**Balances in Manufacturing Cost and Variance Accounts**  
**As of January 31**

<b>Manufacturing cost accounts:</b>		
Materials inventory—R.....		\$ 600.00
Materials inventory—S.....		396.00
<b>Work-in-process inventory:</b>		
Material R.....	\$1,201	
Direct labor—grade A.....	228	
Direct labor—grade B.....	91	
Factory overhead.....	273	1,793.00
Finished goods inventory.....		5,312.00
Cost of sales.....		5,312.00
Total.....		<u>\$13,413.00</u>
<b>Manufacturing variance accounts:</b>		
Materials price variance—R.....		-0-
Materials quantity variance—R.....		\$ 119.00
Labor efficiency variance—A.....		522.50
Labor efficiency variance—B.....		208.50
Labor rate variance.....		-0-
Overhead budget variance.....		363.50
Overhead volume variance.....		763.50
Total.....		<u>\$ 1,977.00</u>

At this point, the balances in the inventory, cost of sales, and variance accounts are as shown in Exhibit 11-10.

### *The partial plan*

#### **Nature of the partial plan**

Under the partial plan, all charges to Work in Process are recorded at *actual* cost. As goods are manufactured and transferred to successive processes or to the finished goods stock room, departmental work-in-process accounts are relieved or credited at the standard cost of the goods transferred. The balance in the Work in Process account consists of the standard cost of uncompleted goods plus or minus variances from standard. Variances are determined by taking a physical inventory, priced at standard cost, and comparing it with the balance in the Work in Process account.

#### **The partial plan illustrated**

Had the Johnson Company used the partial plan instead of the single plan, the Work in Process account would have appeared as shown in Exhibit 11-11.

*Exhibit 11-11*

**THE JOHNSON COMPANY**  
**Work in Process Account**  
**Under the Partial Plan**

Work in Process			
<i>Actual cost</i>		<i>Standard cost</i>	
Material S	144	Finished goods	10,624
Material R	6,600		
Direct labor—A	2,750		
Direct labor—B	1,100		
Factory overhead	3,800		
Balance before adjustment	3,770		

An inventory of goods still in process as of January 31, priced at standard cost, would amount to \$1,793 (see Exhibit 11-10). The total variance would be calculated as follows:

Charges to Work in Process at actual cost.....	\$14,394
Standard cost of goods completed.....	10,624
Balance of Work in Process, Jan. 31.....	\$ 3,770
Less: Physical inventory at standard cost.....	1,793
Unfavorable total variances.....	\$ 1,977

The total variance can be separated into its component elements by analysis of the underlying data. Under this method, variance analysis is facilitated if work-in-process accounts are maintained by cost elements, e.g., Work in Process—Materials, Work in Process—Direct Labor, and Work in Process—Factory Overhead, and the physical inventory is priced accordingly. After the variances have been calculated, they may be transferred out of the Work in Process account by the following entry:

Material Quantity Variance—R.....	119.00	
Labor Efficiency Variance—Grade A.....	522.50	
Labor Efficiency Variance—Grade B.....	208.50	
Overhead Budget Variance.....	363.50	
Overhead Volume Variance.....	763.50	
Work in Process.....		1,977.00

After these variances have been removed from the Work in Process account, the balance represents the standard cost of goods still in process. It will be noted that, in the illustration, the variances are the same under both the single and partial plan. This occurred only because there was no materials price variance. Ordinarily, the amount of the materials price variance will differ under the two methods, since under the single plan the price variance is taken as materials are purchased whereas under the partial plan it is based only on the materials actually used.

## *The dual plan*

The dual plan of standard cost accounting combines the features of the two basic plans discussed. Under the dual plan, charges to Work in Process consist of actual quantities of materials at standard costs, actual hours worked at standard rates, and overhead applied at the standard rate. Completed goods, as under the other methods, are transferred out of Work in Process at standard cost. Under the dual plan, the materials price variance and labor rate variance are calculated on the basis of inputs, in the same manner as under the single plan, i.e., as materials are purchased and direct labor incurred. The overhead budget variance and volume variance also are determined in a manner identical to the calculation under the single plan. However, in order to determine the materials usage variance and labor efficiency variance, it is necessary to take a physical inventory priced at standard cost, as under the partial plan, and compare it with the balance of the Work in Process account. Hence, the disadvantage of having to take a physical inventory under the partial plan also applies to the dual plan.

## *Disposition of variances*

For external reporting purposes, the variances may be dealt with in one of three ways:

1. Writing them off against income of the period
2. Allocating them over cost of sales and ending inventories of work in process and finished goods
3. Writing off the controllable variances against period income and allocating uncontrollable variances over cost of sales and ending inventories of work in process and finished goods

All three of these methods normally would be acceptable to the American Institute of Certified Public Accountants. In this connection, the institute's *Accounting Research Bulletin 43* comments as follows:<sup>1</sup>

Standard costs are acceptable if adjusted at reasonable intervals to reflect current conditions so that at the balance sheet date standard costs reasonably approximate costs computed under one of the recognized bases. In such cases, descriptive language should be used which will express this relationship, as, for instance, "approximate costs determined on the first-in, first-out basis," or, if it is desired to mention standard costs, "at standard costs, approximating average costs."

### *Writing off variances against income*

Under this treatment, all variances are written off against income for the period. Hence, all inventories appearing on the balance sheet are priced

<sup>1</sup> *Accounting Research Bulletin 43*, American Institute of Certified Public Accountants, Committee on Accounting Procedure, New York, 1953, p. 29.



*Exhibit 11-12*

**THE JOHNSON COMPANY**  
**Income Statement**  
**For the Month of January**

Sales.....	\$7,000
Standard cost of sales.....	5,312
Standard gross profit.....	\$1,688
Less: Variances (itemized).....	1,977
Actual gross profit or (loss).....	\$ (289)

at standard cost. If the inventories are priced at standards which were in effect during the expired period and current materials prices and labor rates significantly differ from these standards, this method clearly would not conform to *Bulletin 43*. However, most companies ordinarily revise their standards prior to taking year-end inventories. If current materials prices and labor rates are used, this procedure would be acceptable for external financial reporting. Under this method, an income statement prepared for the Johnson Company at the end of January would appear as shown in Exhibit 11-12. Included in the itemized variances would be an amount for the gain or loss resulting from pricing the inventories at revised standards.

**Allocating variances**

Under this method, variances are allocated over cost of sales and ending inventories of work in process and finished goods. Thus, in effect the ending inventories are priced at amounts approximating actual costs incurred. This would conform to the requirements of *Bulletin 43*. Using this method, the actual costs to be reported on external financial statements would be as follows:

	Standard cost	Approximately 16% variance adjustment	Actual cost
Cost of goods sold.....	\$ 5,312	\$ 845	\$ 6,157
Work-in-process inventory.....	1,793	287	2,080
Finished goods inventory.....	5,312	845	6,157
Total.....	\$12,417	\$1,977	\$14,394

On the balance sheet at the end of the period, the inventories are reported in this manner:

Material R.....	\$600	
Material S.....	396	\$ 996
Work in process.....		2,080
Finished goods.....		6,157
		<u>\$9,233</u>

The disclosure of actual cost on the income statement may be as follows:

Sales.....	\$7,000
Standard cost of sales.....	5,312
Standard gross profit.....	1,688
Less: Variances (itemized).....	845
Actual gross profit.....	<u>\$ 843</u>

### Disposition dependent upon controllability of variance

Under this method, a distinction is made between controllable and non-controllable variances. On the assumption that they are relatively uncontrollable, price and labor rate variances would be allocated over cost of sales and ending inventories of work in process and finished goods. All other variances would be written off against period income, since they are presumed to represent inefficiencies (or efficiencies) that cannot be properly capitalized as inventory charges (or credits). While the volume variance also may be at least partially controllable, adding back the cost of idle facilities to inventories generally is unwarranted. This method is conceptually sound and conforms to the requirements of *Bulletin 43*, provided that the standards represent an attainable level of performance.

## Controllability of variances

The variances which have been identified are:

Materials price variance

Materials usage, quantity, or efficiency variances

Direct-labor rate variance

Direct-labor efficiency variance

Factory-overhead spending, or budget, variance

Factory-overhead volume variance

Actual production costs incurred during a period of time may exceed standard costs for any of several reasons:

1. Utilization of materials, direct labor, or plant in excess of the amount that should be used to do the production work accomplished (usage, quantity, or efficiency variances for materials, direct labor, and factory overhead)

2. Purchase of more expensive direct materials or direct-labor services than anticipated or "allowed for" in the standard (price or rate variances for materials and direct labor)

3. Incurrence of higher factory-overhead costs than anticipated (in the factory-overhead budgetary allowance) for the particular level of operations achieved (factory-overhead spending, or budget, variance)

4. Idleness, or lack of activity (idle capacity, or volume, loss)

Each of these may, in turn, be explained by any of several factors, some of which are controllable and some noncontrollable.

### Reporting variances

The task of variance analysis is to determine and isolate the causes of variances and to report to management those situations which can be corrected or controlled. Some of the causes of variances are outside the control of any level of management. For controllable variances, the amounts and causes of variances are determined, responsibility for the variances is established, and efforts are made to instigate corrective action.

For a control system to operate effectively, it is essential that variances—particularly those which are controllable—be reported as soon as the variation occurs. Corrective action can only be made for *future* production activities. Frequent and timely variance reporting enables the firm to take corrective action and to keep operations in control as production activities take place. Variance analysis is rather useless if it is done only after a project is completed or a time period has passed.

Usually materials and direct-labor variances which are controllable can be reported and corrected on a day-to-day basis. On the other hand, factory-overhead variances—if they are controllable at all—ordinarily are not controllable in such a short time period. Monthly reporting, therefore, may be sufficient.

For a control system to be effective, it is essential also that the "organizational lines" of the firm and the "fixing of responsibility" be certain and explicit. Haphazard definition of policy and responsibility is a weakness found frequently in present-day institutions, including business firms. In such situations, "buck passing" and expediency lessen the usefulness of control systems. Individuals cannot control situations over which they have no authority. In variance analysis, it is very important that the precise and ultimate cause of the variance be determined and that the cause be traced to the appropriate level of management and the individual or group responsible.

Frequently, the responsibility for a variance is a joint one. Corrective action, therefore, must be joint also. This may be accomplished by bringing together, for purposes of seeking a solution, the individuals jointly responsible. In variance analysis, there often are situations in which correction of the out-of-control situation would involve conflict with one of the firm's stated policies. In such cases, the particular policy should be reexamined and perhaps changed. If the conflicting policy is not changed, such a variance must be regarded as uncontrollable by any individual or level of management except that responsible for the particular policy. The ultimate responsibility for a variance thus may rest with the higher levels of management rather than with the lower levels to which responsibility may improperly be assigned if variance analysis is not done carefully.

### Efficiency variances

In standard cost accounting, an efficiency variance ordinarily is computed for materials and direct labor. Usage, quantity, or efficiency variances indicate that more of the materials and direct-labor time are being utilized in accomplishing the production work of the period than should be used according to the standard. Some possible reasons for the excess usage are:

1. Changes in product design or production technique
2. Inferior quality of material
3. Inefficiency and/or spoilage by men or machines

A change in the product design may cause a change in the amount of materials required for a given amount of production, and/or it may require the use of new types of materials. This excess is revealed as a materials quantity variance only if the standard product cost data are not changed to reflect engineering changes. Technically, there would be both a quantity and a price variance due to any new types of materials used because of design changes. For convenience, the two may be combined and identified as a single variance caused by design change. The cost of such design changes may be important information for management planning purposes and for decision making. If so, the standards should not be changed to incorporate the changes in materials requirements, or at least not until after the effect of such changes is known.

Similarly, changes in production methods or processes may necessitate the use of a larger amount of materials or of an additional type of material, which are reflected in materials quantity variances. As with product design changes, a materials quantity or usage variance attributable to this factor may be useful information, in which case the standard should not be changed, at least until the effect is known.

An inferior batch of materials may result in the use of a greater-than-standard quantity of materials and/or an increased amount of materials spoiled. The purchasing and receiving function ordinarily is responsible for the quality of materials and would thus be accountable for the variance. A situation may exist, however, in which it is the policy of the firm to purchase materials only from certain other companies—perhaps companies owned in whole or in part by the firm itself. Where inferior materials are acquired from such companies, the firm's purchasing agent cannot be held responsible for the quality of such materials. Controlling the quantity or usage variance by changing the source of supply would, in this case, be in conflict with policy developed by top-level management. From the purchasing agent's standpoint, the variance is not controllable by him.

A third explanation of a materials quantity or usage variance is inefficiency by production workers using the materials. Such inefficiency may be due to any of several factors such as incompetent employees, newly hired and untrained employees, faulty tools or machines used by employees. Correction of any one of these causes of the variance may



not be possible where there are shortages of labor, where new employees are trained on the job, or where it is impossible to acquire new tools or machines to replace faulty ones. Only a careful analysis will indicate whether or not such a materials quantity variance is controllable by a specific individual or function, particularly at lower levels of management.

The labor efficiency variance indicates that employees are taking too much time to do the production work accomplished. Stated another way, too little is being accomplished in the time taken; hence there is inefficiency. Any of several factors might account for the labor efficiency variance. Some possibilities are:

1. Low-skilled employees
2. Morale, health factors, slowdowns
3. Idle time due to production delays
4. Inferior tools and/or materials
5. Changes in product design and/or production technique

A labor efficiency variance caused by poorly trained employees might be the responsibility of the personnel function. However, if there is a shortage of individuals with a particular skill, this factor may not be controllable by the firm. Employees may take more than the standard time to do a given amount of productive work when they are in less than excellent physical and mental health. Employees with high morale are more productive than others. Employees may deliberately take more than standard time to do their work as in the case of slowdowns encouraged by unions on occasions as a device for bringing pressure upon management. Control of this factor is a responsibility of top management, and in some instances it may not be controlled except by losing control in some other area in labor-management bargaining.

Machines down for repairs, and production bottlenecks and delays caused by lack of materials or sales orders, for example, may be the cause of idle employee time which is reflected in the labor efficiency variance. Daily direct labor utilization reports are an aid in controlling this factor. Working with inferior tools and/or materials may require direct-labor time in excess of standard. Changes in product design or production processes requiring additional direct labor, with no change in standard cost figures, may result in a labor efficiency variance.

### Price variances

The price or rate variance for materials or direct labor is computed as the difference between the actual and standard price or rate (per unit of material or per hour of direct labor) multiplied by actual materials units or direct-labor hours utilized. Frequently, the price variance is not controllable by the firm.

The materials price variance might be analyzed at least into (1) the amount due to economic change and (2) the amount due to negotiation of purchase contracts at prices above those assumed in the standard rates. A general steel price increase is an example of a materials price variance



due to economic change. Such a variance is not controllable by any single firm using steel as a raw material. Materials price variances due to negotiation of materials purchase contracts at prices above standard ordinarily are somewhat controllable by the purchasing function, although this depends largely upon the tightness of the rates assumed in setting the standards for material. The substitution by production personnel of a more expensive grade of material than is necessary according to the standard is revealed by an analysis of the materials price variance.

For direct labor, the standard rate ordinarily is set at the rate contained in the union contract. Where this is done, the standard rate is identical to the actual rate, and there ordinarily is no variance. In spite of this, it may still be worthwhile to compute the labor price variance. This variance, when properly analyzed reveals, for example, any use of higher-grade, more expensive direct labor in production requiring lower-grade, less expensive direct labor.

The factory-overhead budget, or spending, variance is calculated as the difference between the actual factory overhead incurred and that budgeted for the particular level of operations achieved. The factory-overhead budget variance indicates that too much was spent for variable and semivariable items. That is, the amount of the budget variance is the amount by which actual factory-overhead costs exceeded the budgetary allowance for these items at the particular level of operations achieved, assuming the use of an adjusted budget. This may be due to excessive prices paid for each unit of factory overhead goods and services items and/or the consumption or use of too many units, considering the amount of productive work done.

The budget variance should be analyzed into amounts for each item of variable factory overhead, such as indirect labor and indirect materials. The variances for each item then may be further analyzed into price and quantity factors. One way to do this is to use standard rates for major indirect materials and standard rates for indirect labor and separate out the rate and price variances from the utilization factor. For example, the spending variance for indirect materials might be due either to the use of indirect materials which are too expensive and/or to the use of too many of them. The reasons for the specific cause of the variance are examined for controllability, and corrective action is taken where necessary and possible.

## *Problems and cases*

- 11-1 *The single plan.* What are the principal advantages of the single plan of accounting for standard costs over the other plans?
- 11-2 *Revisions of standards.* What problems are presented when standard costs are revised?

**11-3** *Standard costs versus historical costs in performance evaluation.* "I don't see any advantages that standard cost accounting has over historical costs in evaluating performance. By comparing this period's actual cost with past periods, I can tell whether or not there has been any improvement in operating performance." Comment.

**11-4** *Administrative and selling standards.* Why is standard cost accounting not widely used for administrative and selling costs, as in the factory?

**11-5** *Analysis of variances.* How can the materials price variance, materials usage variance, and labor efficiency variance be broken down further to provide valuable information to management on performance evaluation and decision making?

**11-6** *Analysis of variances*

JOE (Cost Accountant): "Moe, your department shows 1,000 labor hours lost as compared with the standard. The boss is sure going to raise Cain. Before delivering the report to him, I thought I had better get your comments."

MOE (Department Supervisor): "My analysis of the 1,000 lost hours is as follows."

300 hr	Due to our low wage rates and the poor grade of workers I get
400 hr	Due to purchasing department buying a cheap grade of materials, which caused a slow-up and higher reject rate
400 hr	Due to plant maintenance department not keeping our machines in good shape
<hr/> 1,100 hr	
100 hr	Due to efficiency
<hr/> 1,000 hr	

Comment on this discussion.

**11-7** *Standards and profit planning.* "The beauty of standard costs is that we can use them for profit projections without the need for adjusting the costs." Comment.

**11-8** *Types of standards.* The controller of a company was attempting to establish a policy regarding the type of standards to use. Indicate the advantages and disadvantages of basing the materials price standard on last year's average price; the current price; the expected price during the coming year.

**11-9** *Waste allowances.* What factors should influence a company's management in regard to the amount of scrap and waste, if any, to provide for in the standards?

**11-10** *Standard costs and joint costs.* "Since we produce joint products, I can't see that standard costs would have any value in our business." Comment.

**11-11** *Standard costs in nonprofit situations.* Do you think that standard cost accounting would be more or less important in nonprofit situations, for example, TVA, Russia, than in profit-oriented situations?

- 11-12 *Psychological aspects of standard costs.* "Standards are a negative approach to performance evaluation." Comment.
- 11-13 *Preciseness of standard costs.* "There is an aura of scientific exactitude about standards that is unwarranted." Comment.
- 11-14 *Favorable factory-overhead variances.* Indicate several factors that may account for a favorable total overhead variance. Which of these factors is within the control of the department manager?
- 11-15 *Costs and stability of production.* It may be argued that stabilized production is a desirable goal because of the fact that a stable operation is easier to manage than an unstable operation. What factors tends to cause unstable operations? Should unstable production be permitted to influence unit costs of product, or should accounting measurement attempt to prevent production fluctuations from making costs erratic?
- 11-16 *Reconstructing the cost flow.* The figures which are presented below were taken from the books of the Black Crow Company. Based on the information given and your analysis of the accounts, you are to insert the correct figure wherever a question mark appears.

	Balance Jan. 31	Debits	Credits	Balance Feb. 28
Raw materials.....	\$ 300	\$ ?	\$?	\$ 500
Materials in process.....	400	?	?	480
Labor in process.....	240	?	?	192
Overhead in process.....	480	?	?	384
Finished goods.....	9,200	?	?	4,600
Materials price variance.....	500	?	?	?
Materials usage variance.....	1,200	100	?	?
Labor rate variance.....	-0-	?	?	?
Labor efficiency variance.....	1,500	?	?	?
Overhead budget variance.....	(300)	?	?	?
Overhead volume variance.....	900	?	?	?
Factory overhead control.....	-0-	12,200	-0-	12,200
Factory overhead applied.....	-0-	?	?	?
Payroll accrued.....	(1,000)	?	?	(800)
Cost of sales.....	92,000	27,600	-0-	119,600

The materials price variance is recorded as materials are purchased. All charges to Work in Process are made at standard cost. Raw materials are used at the start of processing. The factory overhead control and factory overhead applied accounts are closed out each month.

The company manufactures a single product whose material and labor standard costs are as follows:

Materials—10 units @ \$2.....	\$20
Direct labor—12 hr @ \$2.....	24

Standard overhead rates have been established on the following basis:

Monthly budget level.....	3,000 standard hr
Fixed overhead.....	\$ 9,000
Variable overhead.....	3,000
Total.....	<u>\$12,000</u>

*Additional data:* Payroll paid during February amounted to \$7,000. Of the total payroll accrued during the month, \$1,200 represented indirect labor and has been charged to the Factory Overhead Control account. Direct laborers worked a total of 3,000 hours during the month. The actual cost of raw materials purchased was \$5,535.

- 11-17 *Standard cost accounting.* The mixing department of the Glide-On Paint Company mixes two raw materials X and Y and then transfers the mixed preparation in 50-gallon drums to the succeeding department. The company uses a standard cost system. Price variance is calculated at time of purchase. Material in Process is charged at actual quantities and standard prices. Labor in Process is charged for actual hours worked at standard rate. Overhead in Process is charged at actual hours multiplied by the standard overhead rate. Variances are determined by taking physical counts at the end of each month, which are priced at standard cost. The inventories at February 28 and March 31 are shown below:

	Feb. 28	Mar. 31
Material X.....	10,000 lb	24,000 lb
Material Y.....	8,000 lb	12,000 lb
In process.....	20 drums, 100% complete as to materials and 25% converted	40 drums, 100% complete as to materials and 50% converted

The standard cost of a drum of mixed preparation is:

Materials:	
X, 30 lb @ \$.50.....	\$15.00
Y, 20 lb @ \$.30.....	6.00
Direct labor, 2 hr @ \$2.80.....	5.60
Variable overhead, 2 hr @ \$1.60.....	3.20
Fixed overhead, 2 hr @ \$2.....	4.00
Total.....	<u>\$33.80</u>

The budgeted monthly level of activity, i.e., the basis for setting overhead rates, is 1,200 standard hours.

Transactions during March were as follows:

Purchases:	
Material X (\$.51 per lb).....	\$15,300
Material Y (\$.33 per lb).....	\$4,950
Direct labor (1,100 hr).....	\$3,190
Actual overhead incurred.....	\$3,800
Completed and transferred to finished goods.....	500 drums

*Required:* Record all journal entries based on the foregoing information (three overhead variances).

- 11-18 *Standard cost accounting.* The Carter Company uses a standard cost system. The materials price variance is calculated at the time materials are purchased. The company produces a single product, Alpha, for which the standard cost is shown below.

Alpha—Standard Cost	
Raw material, 10 units @ \$2.....	\$20
Direct labor, 6 hr @ \$3.....	18
Variable overhead, 6 hr @ \$1.....	6
Fixed overhead, 6 hr @ \$3.....	18
Total.....	\$62

The company takes an inventory of work in process at the close of each month, which is priced at standard cost and recorded in the process accounts accordingly. Materials are charged to Materials in Process at the standard cost of the actual quantities requisitioned. All credits to Work in Process and charges to Finished Goods are made at standard cost. Budgeted fixed overhead per month is \$30,000.

At the beginning of the month, 200 units of Alpha were in process, 100 percent complete as to materials and 50 percent as to conversion costs. At the end of the month, there were 240 units in process, 100 percent complete as to materials and one-third as to labor and overhead.

You find the balances in the accounts shown below:

<u>Materials in Process</u>		<u>Labor in Process</u>		<u>Overhead in Process</u>		<u>Finished Goods</u>	
4,000	30,000	1,800	27,000	2,400	36,000	6,200	96,100
32,000		29,280		38,400		93,000	
<u>Factory Overhead Control</u>		<u>Factory Overhead Applied</u>		<u>Labor Rate Variance</u>		<u>Labor Efficiency Variance</u>	
40,500			38,400				
<u>Overhead Efficiency Variance</u>		<u>Overhead Budget Variance</u>		<u>Overhead Volume Variance</u>			
<u>Payroll Accrued</u>							
				(9,600 d.l. hr)	29,280		
				(Indirect labor)	5,000		

*Required:* Based on the information given and your analysis of the accounts, calculate all variances, and record the entries to complete the accounts.



- 11-19** *Analysis of factory-overhead variances.* The H. G. Company uses a standard cost system in accounting for the cost of one of its products. The standard is based on budgeted monthly production of 100 units per day for the usual 22 workdays per month. Standard cost per unit for direct labor is 16 hr at \$1.50 per hour. Standard cost for overhead was set as follows:

Fixed overhead per month.....	\$29,040
Variable overhead per month.....	39,600
Total budgeted overhead.....	<u>\$68,640</u>
Expected direct labor cost.....	<u>\$52,800</u>
Overhead rate per dollar of labor.....	\$ 1.30
Standard overhead per unit.....	<u>\$ 31.20</u>

During the month of September, the plant operated only 20 days. Costs for the 2,080 units produced were:

Direct labor, 32,860 hr @ \$1.52.....	\$49,947.20
Fixed overhead (incurred).....	29,300.00
Variable overhead (incurred).....	39,065.00

You are required to:

1. Compute the variance from standard in September for (a) direct-labor cost and (b) overhead.
2. Analyze the variances from standard into identifiable causes for (a) direct labor and (b) for fixed and variable overhead.

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- 11-20** *Standard costs and variance analysis for control.* The R. U. Bright Co. manufactures two products, X and Y. Each product requires the same type of material and labor, but different amounts are required for each product. Production is continuous and is coordinated with sales through changes in Finished Goods Inventory levels. Sales are relatively stable.

For management control purposes, standard costs are integrated into the formal accounting system. Variances of actual costs from standard costs are analyzed at the end of each week, and action is taken to correct the conditions which need attention. Materials price variance is calculated on materials purchases rather than on materials usage.

The standard costs for products X and Y as shown on the standard cost cards are as follows:

	One unit of product X	One unit of product Y
Material.....	2 units @ \$4	4 units @ \$4
Direct labor.....	3 hr @ \$2.50	6 hr @ \$2.50
Factory overhead.....	3 hr	6 hr

Factory overhead is based on direct-labor hours.

The firm uses a predetermined factory-overhead rate based on estimates of direct-labor hours and factory overhead for the calendar month. Thus, a new

rate might be calculated at the beginning of each month, based on estimates for that month.

For purposes of control through variance analysis made at the end of each week, the firm uses flexible budgets.

For the month of March, assume the following budgetary data for factory overhead:

Estimated direct-labor hr.....	30,000
Estimated factory overhead:	
Variable.....	\$15,000
Fixed.....	22,500

For the work week of March 16-22, assume the following data:

Actual production of X.....	1,000 units
Actual production of Y.....	800 units
Actual direct-labor hours worked.....	8,000 hr
Actual direct-labor wage rate.....	\$2.60
Actual purchases of material.....	6,000 units @ \$4.80
Actual materials issued to production.....	5,700 units
Variable factory overhead incurred.....	\$4,350
Fixed factory overhead incurred.....	\$5,625

There is no Work in Process Inventory at either the beginning or the end of the week.

Flexible factory-overhead budget data for control use at the end of the week of March 16 to 22 are as follows:

Variable factory-overhead allowance.....	\$4,000
Fixed factory-overhead allowance.....	5,625

You are to calculate the following variances (1 through 7). Do not use joint variances for labor and material.

1. Materials price variance.
2. Materials quantity (usage) variance.
3. Labor rate (price) variance.
4. Labor efficiency (usage) variance.
5. Factory-overhead budget (spending) variance.
6. Factory-overhead capacity (activity) variance.
7. Factory-overhead efficiency variance.
8. Which factory-overhead variance is due entirely to fixed costs?
  - a. Budget
  - b. Capacity
  - c. Efficiency
9. Which factory-overhead variance is due entirely to variable costs?
  - a. Budget
  - b. Capacity
  - c. Efficiency

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namely, operations M-10 to M-12, inclusive, in which the manufacturing cost of such unit is developed as shown by the following tabulation of percentages of cost of manufacture:

Cost of Manufacture of Unit M			
Operation	Material, %	Labor, %	Overhead, %
M-10	20	20	40
M-11		35	40
M-12	80	45	20
Total.....	100	100	100

(The company does not record the actual labor charges applicable to each operation.)

The Bunson Company operates a cost accounting system based on standard costs which are incorporated in the manufacturing cost accounts. The differences between standard costs and actual costs are reflected in appropriate variance accounts, namely, materials price, materials usage, direct-labor rate, direct-labor time, and over-all manufacturing overhead. The materials price variance is assumed to be realized at the time of purchase, irrespective of time of usage.

The standard manufacturing costs used for unit M (based on a planned monthly production ranging between 8,000 and 12,000 units M) are as follows:

	Per unit M	
	Quantity or hours	Amount
Material:		
Item M-a (issued in operation M-10).....	1	\$ .50
Item M-b (issued in operation M-12).....	1	2.00
Direct labor (total for all operations at uniform rate of \$5 per hr).....	$\frac{1}{4}$ hr	1.25
Overhead (applicable to operations as a whole):		
Variable expenses.....		.60
Fixed expenses.....		.90
		<u>\$5.25</u>

The inventories applicable to unit M as at December 31, 19\_\_\_\_\_, stated in accordance with the foregoing exhibit of standard costs, are as follows:

Materials: Item M-a, 100 units; item M-b, 100 units  
 Work in Process: 50 units complete through operation M-10  
 Finished goods: None

Transactions during January, 19\_\_\_\_\_, are submitted as follows:

The voucher register reflects applicable transactions paid and incurred as follows:

	<i>Amount</i>
Materials purchases:	
Item M-a, 12,000 units @ \$0.45 per unit.....	\$ 5,400
Item M-b, 12,000 units @ \$2.10 per unit.....	25,200
Payroll for all operations:	
Direct labor, 3,100 hr @ \$1.2625 per ¼ hr.....	15,655
Indirect labor.....	1,500
Manufacturing overhead, other than indirect labor...	15,000
Selling, administrative, and general expenses.....	25,000

Other data are:

During January, 19\_\_\_\_\_, 11,000 units M were transferred to the finished goods warehouse, and 10,500 units were sold at \$9 per unit M.

As of January 31, 19\_\_\_\_\_, 100 units of work in process are complete through operation M-11.

Stores requisitions indicate issuances of materials items M-a and M-b in the quantities required for the production carried through the respective operations. A supplementary stores requisition, however, indicates that item M-a actually used was 2 percent in excess of the standard quantity required.

*Required:* From the above information, prepare an income statement showing appropriate manufacturing cost variances of the Bunson Company for January, 19\_\_\_\_\_, supported by journal entries of transactions for the month.

- 11-22** *Flow of standard costs in the accounts; variance analysis; standard cost and variance reports.* The Smith Company uses a standard cost system. The standards are based on a budget for operations at the rate of production anticipated for the current period. The company records, in its general ledger, variations in materials prices and usage, wage rates, and labor efficiency. The accounts for manufacturing expenses reflect variations in activity from the projected rate of operations, variations of actual expenses from amounts budgeted, and variations in the efficiency of production.

Current standards are as follows:

Materials:	
Material A.....	\$1.20 per unit
Material B.....	\$2.60 per unit
Direct labor.....	\$2.05 per hr

	<i>Special widgets</i>	<i>De luze widgets</i>
Finished products (content of each unit):		
Material A.....	12 units	12 units
Material B.....	6 units	8 units
Direct labor.....	14 hr	20 hr

The general ledger does not include a Finished Goods Inventory account; costs are transferred directly from Work in Process to Cost of Sales at the time finished products are sold.

The budget and operating data for the month of August are summarized as follows:

<b>Budget:</b>		
Projected direct-labor hours.....		9,000
Fixed manufacturing expense.....		\$4,500
Variable manufacturing expenses.....		\$13,500
Selling expenses.....		\$4,000
Administrative expenses.....		\$7,500
<b>Operating data:</b>		
<b>Sales:</b>		
500 special widgets.....		\$52,700
100 de luxe widgets.....		\$16,400
<b>Purchases:</b>		
Material A.....	8,500 units	\$9,725
Material B.....	1,800 units	\$5 635
	<i>Material A</i>	<i>Material B</i>
<b>Materials requisitions:</b>		
<b>Issued from stores:</b>		
Standard quantity.....	8,400 units	3,200 units
Over standard.....	400 units	150 units
Returned to stores.....	75 units	
<b>Direct-labor hours:</b>		
Standard.....		9,600 hr
Actual.....		10,000 hr
<b>Wages paid:</b>		
500 hr at.....		\$ 2.10
8,000 hr at.....		2.00
1,500 hr at.....		1.90
<b>Expenses:</b>		
Manufacturing.....		20,125
Selling.....		3,250
Administrative.....		6,460

**Required:**

1. Prepare journal entries to record operations for the month of August. Show computations of the amounts used in each journal entry. Raw materials purchases are recorded at standard.
2. Prepare a statement of profit and loss for the month, supported by an analysis of variations.

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**11-23** *Flow of standard costs in the accounts; adjustment of standard costs to actual costs; variance analysis.* The Johnson Company began operations on January 1. It manufactures a single product. The company has installed a standard cost system, but it will adjust all inventories to actual cost for financial-statement purposes at the end of the year.

Under the cost system, Raw Materials Inventory is maintained at actual cost. Charges made to Work in Process are all made at standard prices. Vari-



ance accounts are used into which all variances are entered as they are identified.

One-half of the cost of raw materials for each unit is put into production at the beginning of the process and the balance when the processing is about one-third completed.

Standard cost was based on 256,000 direct-labor hours with a production of 1,600 units. The standard was as follows:

Materials (100 lb @ \$2).....	\$200
Direct labor (160 hr @ \$1.25).....	200
Manufacturing expense (based on direct-labor hours) (160 @ \$0.25).....	40
Total standard cost per unit.....	\$440

A summary of the transactions for the year ended December 31 shows the following:

Material purchased (180,000 lb @ \$2.20).....	\$396,000.00
Direct labor (247,925 hr @ \$1.30).....	\$322,302.50
Manufacturing overhead.....	\$49,585.00
Materials issued to production.....	177,600 lb

Units processed:

Units completed.....	1,500
Units $\frac{1}{2}$ complete.....	150
Units $\frac{1}{4}$ complete.....	30

1. Using the T accounts indicated below, record the transactions in the manufacturing accounts only for the year. In each account, give an indication of the nature of each item recorded. Assume budgeted factory overhead of \$64,000. Do not use any additional accounts.
2. Using the skeleton ledger accounts in which costs were recorded, make the entries needed to adjust Finished Goods to the actual cost for materials. Give identifiable supporting computations showing clearly the method of arriving at each adjustment. You need not adjust for labor or manufacturing expense.
3. Prepare a statement showing details of the materials cost included in Work in Process Inventory as adjusted to actual cost.

Note: The following accounts are to be used:

Raw materials	Materials quantity variance
Direct labor	Labor rate variance
Manufacturing expense	Labor hours variance
Work in process	Manufacturing expense efficiency variance
Finished goods	Manufacturing expense capacity variance
Materials price variance	Manufacturing expense budget variance

(AICPA)

**11-24** *Controllability of variances; standard costs by process; revision of standard costs.* Following is the previously computed standard cost of product X, manufactured by the XYZ Manufacturing Company:

	Prime cost	Manufacturing burden, 50%	Total
Material A.....	\$10		\$10.00
Material B.....	5		5.00
Material C.....	2		2.00
Direct labor—cutting.....	8	\$4.00	12.00
Direct labor—shaping.....	4	2.00	6.00
Direct labor—assembling.....	2	1.00	3.00
Direct labor—boxing.....	1	.50	1.50
Total.....	\$32	\$7.50	\$39.50

The budget called for the manufacture of 10,000 of product X at a total cost of \$395,000 for the period under review.

The following variance accounts relating to product X appear on the books for the period:

	Debit	Credit
Materials price variance*		
Because of a favorable purchase of total requirements of material A.....		\$19,500
Materials usage variance		
Excessive waste during period.....	\$ 3,000	
Labor rate variance*		
5% wage increase to direct workers.....	7,500	
Labor productivity variance		
Because of shutdown caused by strike.....	15,000	
Burden variance—fixed overhead		
Because of shutdown caused by strike.....	6,000	
Burden variance*—variable overhead		
Because of permanent savings in costs of certain services.....		12,000
Total.....	\$31,500	\$31,500

\* Revised standard cost indicated.

The inventory at the end of the period is as follows:

100 units material A @ \$10.....	\$ 1,000
100 units material B @ \$5.....	500
100 units material C @ \$2.....	200
200 units product X in process—cut, @ \$29.....	5,800
200 units product X in process—shaped, @ \$35.....	7,000
200 units product X in process—assembled, @ \$38.....	7,600
200 units product X finished and boxed @ \$39.50.....	7,900
Total.....	\$30,000

Required:

1. An exhibit of revised standard cost which will clearly indicate the cumulative standard for each successive operation
2. An exhibit applying the revised standard to the ending inventory

- 11-25 *Estimated costs; adjustment of estimated costs to actual costs.* The R Manufacturing Company estimates its cost for a unit of product X to consist of the following:

Materials—5 lb @ \$1.22 per lb  
 Labor—7 hr @ \$1.30 per hr

Overhead is applied on a direct-labor basis and need not be considered in this problem.

The company takes the raw materials purchased into Inventory of Raw Materials at \$1.22 per pound, recording any difference between that price and actual purchase cost in a Price Variation—Materials account. The actual raw materials used are issued to production at \$1.22 per pound. The materials cost and the actual direct-labor cost for the month are recorded in separate work-in-process accounts. Finished Goods Inventory is debited, and these process accounts are credited with the estimated cost of completed units. At the end of the month the Finished Goods account and the work-in-process accounts are adjusted to actual cost by spreading the differences between actual costs and estimated costs over the accounts in proportion to the amounts of estimated costs applicable to each of the accounts. Materials price variation is spread over Inventory of Raw Materials, Work in Process, and Finished Goods in the same manner as other variations, but the amount applicable to Inventory of Raw Materials is left in the Variation account.

Account balances after adjustment for March 31, but before adjustment to actual costs for April 30, were as follows:

<i>Account</i>	<i>Debit balances Mar. 31 after adjustment</i>	<i>Debit balances Apr. 30 before adjustment</i>
Inventory of raw materials.....	\$10,485.90	\$10,673.78
Price variation—materials.....	723.55	973.28
Work in process—materials.....	770.80	1,091.90
Work in process—labor.....	731.15	758.94

The March 31 balance of Work in Process—Materials includes \$49.78 of Price Variation.

Status of the work in process was as follows:

	<i>Mar. 31</i>		<i>Apr. 30</i>	
	<i>Units</i>	<i>% completed</i>	<i>Units</i>	<i>% completed</i>
Materials.....	60	50	50	30
Materials.....	80	90	100	75
Labor.....	60	25	50	10
Labor.....	80	80	100	60

During the month of April, 510 units of product X were completed and transferred to Finished Goods.

You are to set up skeleton ledger accounts for all the accounts affected by these transactions and prepare and post the adjustments necessary for the company as of the end of April.

(AICPA)

## 12. **Cost-Volume-Profit Analysis**

( Profit planning, cost control, and decision making require an understanding of the characteristics of costs and their behavior at different operating levels. While cost trends cannot be predicted with certainty, they generally follow a sufficiently regular pattern to be useful for profit planning, cost control, and management decisions.

The relationship between costs and revenues, and therefore profits, at different levels of activity may be expressed graphically or in report form. Both methods of presentation are illustrated in this chapter. Either method represents a more dynamic type of presentation than the traditional income statement. The income statement reflects a profit only at a specified sales level and does not detail the fixed and variable nature of costs. By failing to distinguish between fixed and variable costs, the traditional income statement does not lend itself to profit forecasting at different levels of operation.

Cost-volume-profit analysis applies not only to projections of income. This analysis is relevant to virtually all decision-making areas. It is useful in product decisions, pricing, selection of channels of distribution, make or buy decisions, determination of alternative production methods, capital investments, etc. Cost-volume-profit analysis represents the basis for establishing the variable budget and thus is a valuable tool for planning and control. )

### *Variability of costs*

Cost-volume-profit analysis depends upon a careful segregation of costs, according to variability. Costs seldom fit into the theoretically neat categories of completely variable or completely fixed, nor, indeed, are variable costs always *perfectly* variable or fixed costs *perfectly* fixed.

Fixed costs are only relatively fixed and for limited periods of time. In the long run, all fixed costs become variable. Even in short periods of

time, the replacement of machinery or other assets with more expensive substitutes raises fixed costs. The fact that firms are less apt to discharge workers with small decreases in volume than they are to employ additional workers with increases in volume obscures the distinctly fixed or variable nature of labor costs.

Semivariable costs are partially fixed and partially variable. Even when a plant is shut down, some light and heat are required, for example. Maintenance cost also is incurred during plant shutdowns.

Some costs classed as variable costs have a curvilinear rather than a linear relationship to their activity base; that is, they vary differently at different levels of output. As production rises, power costs tend to increase but at a declining rate, whereas repairs tend to pursue a reverse course. At higher volumes, quantity discounts may be obtained which may not be available for smaller quantities purchased at lower activity levels. The efficiency of labor may vary with the total size of the labor force.

In a specialized case, one might suggest that accounting procedures—the method of computing depreciation—also affect the degree of variability of reported costs. If depreciation is calculated on a straight-line basis, it is a fixed cost, but if computed on a usage or service-output basis, it technically appears to be a variable cost. Most accountants probably would agree, however, that depreciation is a fixed cost regardless of the method of computing it for income determination purposes.

### Determining the variability of costs

In order to determine the variability of costs, it first is necessary to isolate the various elements of production cost. Although accounting records provide the starting point, accounting classifications frequently are too broad and include cost elements that do not vary in the same manner. For example, the category "supplies" may contain some items that are relatively fixed, such as cleaning fluids for the building, and others that are relatively variable, such as machine-lubricating oils. Historical cost data from the accounting records must be adjusted for price fluctuations and for known changes in operating conditions.

After segregating the individual cost elements, it is necessary to correlate each of them with a variable base. Most costs, at least initially, do not yield close correlations with a variable base. The practice of using sales as the basis for measuring the variability of all costs does not produce entirely accurate results. Factory costs may not have a close correlation with sales because of the seasonal nature of the industry and the need for inventory "build-ups." For this reason, many companies find it desirable to use the *sales value of production* as the over-all basis for cost variability.

While scattergraphs and mathematical methods provide the most precise analysis of the variability of historical costs, these methods seldom



are used in practice, according to a survey conducted by the National Association of Accountants.<sup>1</sup> More commonly, assignment of costs to fixed or variable categories occurs by inspection of the chart of accounts or through industrial engineering studies. When the analysis is made by inspection, the chart of accounts must be sufficiently detailed. Costs should be classified according to object of expenditure as well as by function, e.g., supplies—production control, since an account which is variable in one department may be fixed in another.

### Underlying assumptions in the use of cost-volume-profit data for profit planning and cost control

While cost-volume-profit data provide management with a useful device for planning and control, these data should not be regarded as a precise tool. Cost-volume-profit data are based upon certain assumed conditions which rarely can be realized completely in practice. The analyst must be aware of these limitations and should be prepared to interpret the data accordingly. Some of these basic assumptions are:

1. That the actual sales mix will conform to the predicted mix. A large diversified company generally sells many product lines with varying profit margins. The relationship between over-all costs and profits is dependent upon the ability to forecast sales volume for each product line with a reasonable degree of accuracy.
2. That the selling prices of products do not vary at different levels of activity. If it becomes necessary to reduce prices or offer discounts in order to attain greater sales volume, the cost-volume-profit relationship will be affected. Normally, the assumption made is that product prices will remain constant during the period covered and that they will not vary from one level of activity to another.
3. That the productive capacity of the plant will remain relatively constant. An expansion of facilities will affect the relationship between costs, volume, and profit.
4. That the efficiency of the plant will be as predicted. The use of lower-cost substitute materials, the replacement of hand operations by machinery, and similar cost reduction programs clearly affect the relationship between costs and profits.
5. That materials prices and labor rates will not vary significantly from the data on which the cost-volume-profit projections are based.
6. That the variability of costs will adhere reasonably closely to the predicted pattern. In this connection, it should be mentioned that break-even charts assume that a variable cost is perfectly variable regardless of

<sup>1</sup> *The Analysis of Cost-Volume-Profit Relationships*, National Association of Accountants Research Report, New York, 1962. This report is comprised of National Association of Cost Accountants Research Reports 16-18, originally published in 1949 and 1950; note that the name of the association was changed in 1957 from National Association of Cost Accountants (NACA) to National Association of Accountants (NAA).

the level of activity. Some economic theorists assume that the efficiency with which the variable input factors are utilized decreases as a firm approaches full capacity. Empirical studies made by Joel Dean<sup>2</sup> and others, however, do not support this conclusion.

The analyst who attempts to project or to interpret cost-volume-profit data without an awareness of these basic limitations may be lured into unwarranted conclusions. While the past contains elements for predicting future behavior, it would be unwise to assume that patterns of the past automatically will continue. Each element in the analysis should be examined carefully in regard to probable future trends, the past serving merely as a guide.

A characteristic of all forecasting is that the longer the future time span involved, the less reliable past data become as a basis for prediction. Long-range cost-volume-profit projections evoke such basic considerations as the development of new product lines, expansion of existing facilities, changes in product mix and prices, and changes in cost trends. The analyst also must use caution in applying cost-volume-profit data based on over-all company operations to specific segments of the business. Generally, this type of data is most useful when prepared for smaller sectors of the business such as product lines and plants, where greater homogeneity of data exists.

### Presentation of cost-volume-profit data

After the fixed and variable elements of each cost have been determined, a forecast of profits at different levels of operation may be prepared as shown in Exhibit 12-1. It will be observed (in Exhibit 12-1) that revenue and costs are computed only from 50 to 100 percent of capacity levels. This is the practical range, in this case, within which the plant may be expected to operate. However, one should note that costs which are fixed at these volumes may actually decrease at lower operating levels. Although subsequent charts will project these costs to the 0 level, from a practical standpoint, our interest lies only in the 50 to 100 percent of capacity range.

The variable warehouse and shipping costs in Exhibit 12-1 are equal to 3 percent of sales. The fixed element of these costs (\$300,000) is included among the fixed costs. The same type of segregation applies to each of the other semivariable costs. The variable portion of utility costs, equal to  $2\frac{1}{2}$  percent of sales, is shown among the variable costs, while the fixed element of utility costs is included in the total fixed factory overhead of \$7 million.

<sup>2</sup> See Joel Dean, *Statistical Determination of Costs with Special Reference to Marginal Costs* (Chicago: The University of Chicago Press, 1936); *Statistical Cost Functions of a Hosiery Mill Belt Shop* (Chicago: The University of Chicago Press, 1941); and *The Relationship of Cost to Output for a Leather Belt Shop* (New York: National Bureau of Economic Research, 1941).

*Exhibit 12-1*Forecast of Revenue and Costs at Different Sales Volumes  
(In thousands of dollars)

	<u>50%</u>	<u>60%</u>	<u>70%</u>	<u>80%</u>	<u>90%</u>	<u>100%</u>
Plant capacity (5-day-2-shift).....						
Sales.....	<u>\$20,000</u>	<u>\$24,000</u>	<u>\$28,000</u>	<u>\$32,000</u>	<u>\$36,000</u>	<u>\$40,000</u>
Variable costs:						
Materials.....	\$ 6,000	\$ 7,200	\$ 8,400	\$ 9,600	\$10,800	\$12,000
Direct labor.....	2,000	2,400	2,800	3,200	3,600	4,000
Factory overhead:						
Supervision.....	300	360	420	480	540	600
Clerical work.....	40	48	56	64	72	80
Materials handling.....	20	24	28	32	36	40
Wage premiums.....	40	48	56	64	72	80
Welfare provisions.....	200	240	280	320	360	400
Repairs and maintenance.....	300	360	420	480	540	600
Supplies.....	350	420	490	560	630	700
Utilities.....	500	600	700	800	900	1,000
Miscellaneous.....	100	120	140	160	180	200
Warehousing and shipping.....	600	720	840	960	1,080	1,200
Selling and administrative expenses	1,550	1,860	2,170	2,480	2,790	3,100
Total variable costs.....	<u>\$12,000</u>	<u>\$14,400</u>	<u>\$16,800</u>	<u>\$19,200</u>	<u>\$21,600</u>	<u>\$24,000</u>
Margin available for fixed costs and profit.....	<u>\$ 8,000</u>	<u>\$ 9,600</u>	<u>\$11,200</u>	<u>\$12,800</u>	<u>\$14,400</u>	<u>\$16,000</u>
Fixed costs:						
Factory overhead.....	\$ 7,000	\$ 7,000	\$ 7,000	\$ 7,000	\$ 7,000	\$ 7,000
Warehousing and shipping.....	300	300	300	300	300	300
Selling and administration expenses	2,700	2,700	2,700	2,700	2,700	2,700
Total fixed.....	<u>\$10,000</u>	<u>\$10,000</u>	<u>\$10,000</u>	<u>\$10,000</u>	<u>\$10,000</u>	<u>\$10,000</u>
Profit.....	<u>\$ (2,000)</u>	<u>\$ (400)</u>	<u>\$ 1,200</u>	<u>\$ 2,800</u>	<u>\$ 4,400</u>	<u>\$ 6,000</u>
Return on sales, %.....	(10.0)	(1.7)	4.3	8.8	12.2	15.0
Return on invested capital, %.....	(12.2)	(2.4)	6.9	15.6	23.9	31.8
Capital investment required (estimated).....	\$16,400	\$16,900	\$17,400	\$17,900	\$18,400	\$18,900

The estimated, or planned, percentage return on sales and invested capital, at different levels of operation, also is shown in Exhibit 12-1. In order to calculate the return on capital, an estimate must be made of what the capital investment will be at varying levels of activity.

The investment in plant and equipment remains fixed regardless of the level of activity, whereas the investment in accounts receivable varies with the volume of sales. Other assets, such as cash and inventories, are partly fixed and partly variable. A certain amount of cash is required even when the plant is shut down, i.e., for payment of taxes, insurance, maintenance, etc. However, as the level of activity rises, the cash requirements increase. In Exhibit 12-1, the fixed capital requirement amounts to \$13,900, and the variable capital requirement is 12.5 percent of sales.

## Break-even analysis

### The break-even chart

Cost-volume-profit data may be shown graphically in the form of a break-even chart (Fig. 12-1). The break-even chart discloses the estimated profit that will be realized at different sales volumes. The chart also indicates the minimum sales which a company must achieve in order not to sustain losses.

An efficient company must operate above the break-even point in order to replace its equipment, distribute dividends, and provide for growth. In regard to asset replacement, one should bear in mind that accounting depreciation is based on the original cost of the assets whereas replacement often takes place in a higher cost market. An adjustment of the fixed costs can be made to take this into consideration.

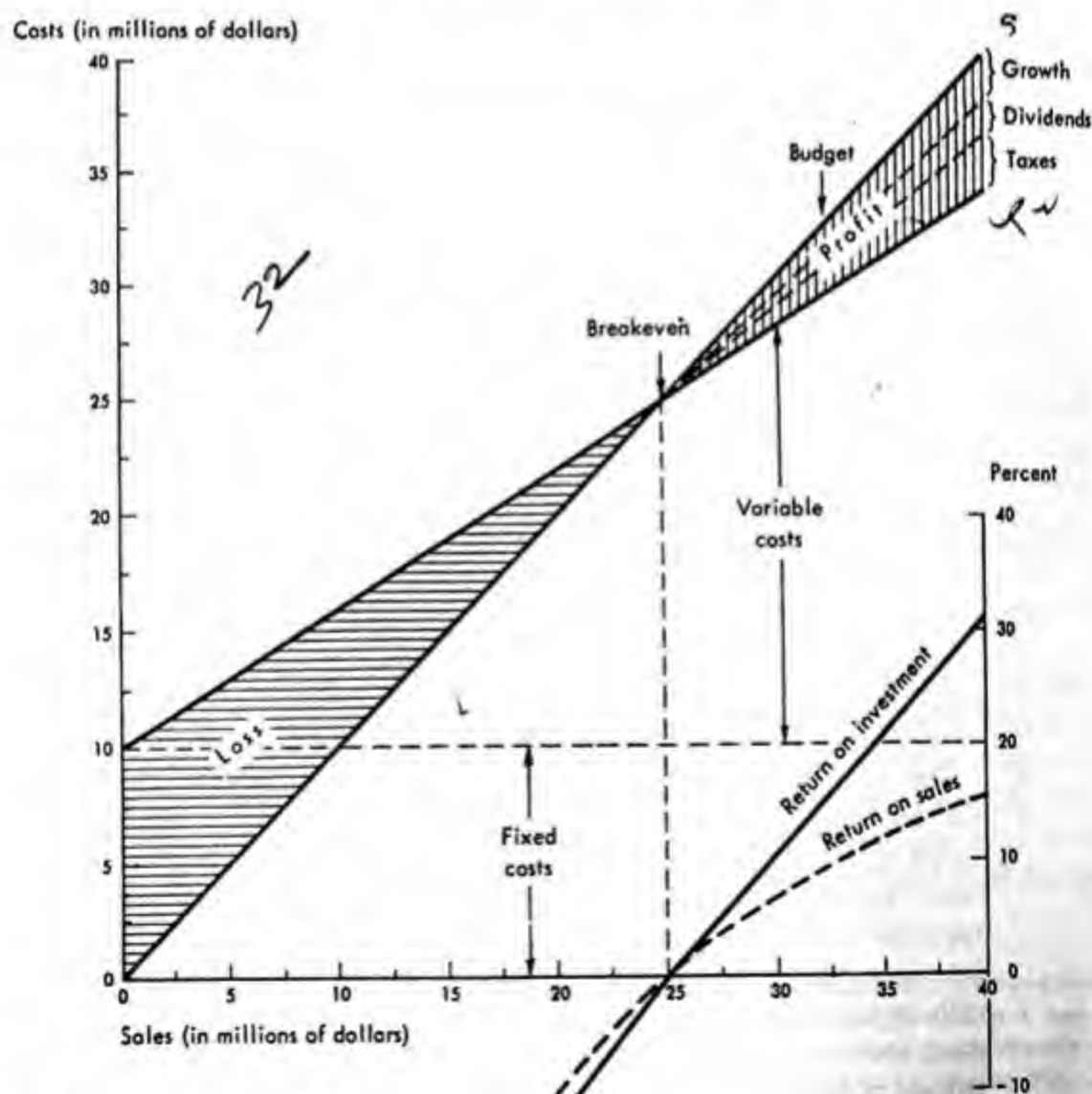


Fig. 12-1 Break-even chart.



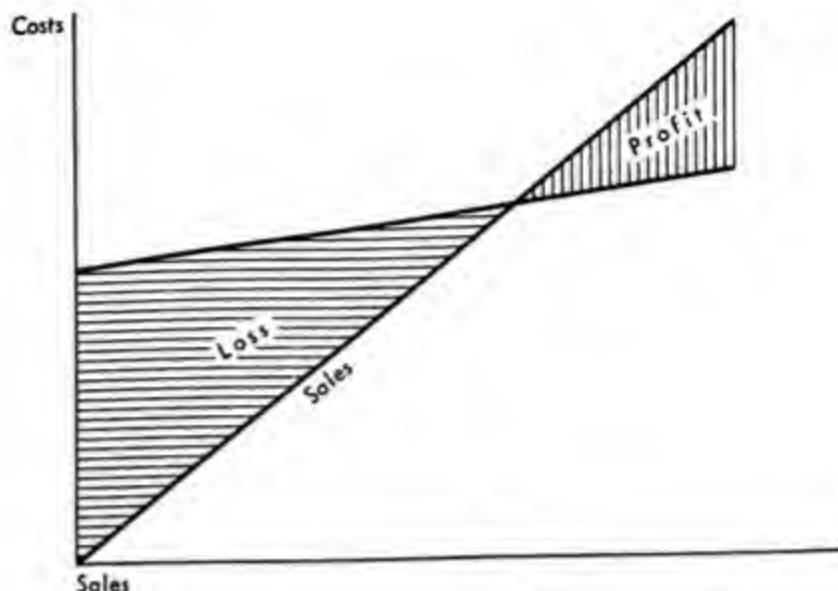


Fig. 12-2 Break-even chart for companies with heavy fixed costs.

Figure 12-1 shows the rate of return on sales and invested capital at the different operating levels possible within the existing plant capacity. The rate of acceleration of the line representing return on investment is much sharper than the line for return on sales. This occurs because in the example, and generally in highly mechanized concerns, the capital investment consists predominantly of fixed assets. The rate of acceleration of the line representing return on sales is less sharp, because a large portion of the costs are variable.

The break-even point may be derived mathematically as follows:

$$\begin{aligned}
 \text{Break-even point} &= \frac{\text{fixed costs}}{1 - (\text{variable costs/sales})} \\
 &= \frac{\$10,000,000}{1 - .60} \\
 &= \$25,000,000
 \end{aligned}$$

### The significance of break-even patterns

The pattern of a break-even chart provides an indication of the nature of the business activity and emphasizes the major type of executive action required. Companies that have very heavy fixed costs normally will have a break-even chart somewhat as shown in Fig. 12-2.

The major objective of companies with heavy fixed costs, e.g., utilities, hotels, theaters, is the maximization of revenue. Hotels find it economically profitable to offer reduced "off-season" rates, provided the additional revenue derived exceeds out-of-pocket costs. Stated another way, this action is profitable to the extent that there is a positive *contribution* margin (added, or marginal, revenue, or marginal income minus marginal or variable costs). Theaters can afford to have special low-price



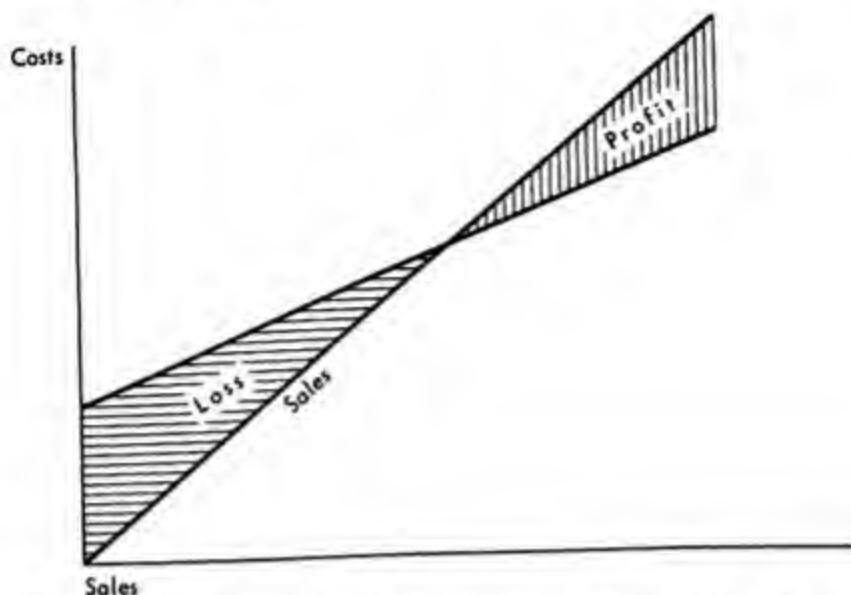


Fig. 12-3 Break-even chart for companies without heavy fixed costs.

matinees for children. Airlines can offer reduced family rates for early morning flights, when planes might otherwise be relatively empty.

The break-even chart for companies that do not have heavy fixed costs might appear as shown in Fig. 12-3. In the clothing, food, and household appliance industries, where costs consist to a greater extent of purchased materials and assembly labor, the break-even chart is more apt to assume this form. In such industries, major emphasis should be placed on improving the cost-price relationship so that the break-even point can be lowered and the profit margin widened. Cost reduction efforts are of particular importance in such industries.

### Break-even analysis and plant-shutdown decisions

In certain decisions a distinction should be made between out-of-pocket and sunk costs. Variable costs generally may be regarded as out-of-pocket costs. Fixed costs may fall into either category. Out-of-pocket fixed costs, while not varying with changes in output, nevertheless represent cash payments to be incurred, e.g., plant supervision, rent, utilities. Sunk fixed costs represent expenditures previously made from which benefits still remain to be obtained, e.g., depreciation.

The difference between sales revenue and total out-of-pocket costs equals cash profit. By analyzing each of the costs which appear in Exhibit 12-1, cash profits and accounting profits may be distinguished from each other, as shown in Exhibit 12-2.

The data contained in Exhibit 12-2 may be plotted as shown in Fig. 12-4. While the break-even point is at \$25 million of sales, the shutdown point is substantially lower, at \$10 million of sales. If the company operates at any point below \$10 million in sales, cash receipts will be exceeded by the out-of-pocket costs, and it will be desirable to close the plant. Actually, in a decision of this type, other considerations are in-

Exhibit 12-2

Forecast of Out-of-pocket and Sunk Costs at Different Sales Volumes  
(In thousands of dollars)

Sales volume	Variable out-of-pocket costs	Fixed costs		Profits	
		Out-of-pocket	Sunk	Accounting	Cash
\$20,000	\$12,000	\$4,000	\$6,000	\$(2,000)	\$ 4,000
24,000	14,400	4,000	6,000	(400)	5,600
28,000	16,800	4,000	6,000	1,200	7,200
32,000	19,200	4,000	6,000	2,800	8,800
36,000	21,600	4,000	6,000	4,400	10,400
40,000	24,000	4,000	6,000	6,000	12,000

Costs (in millions of dollars)

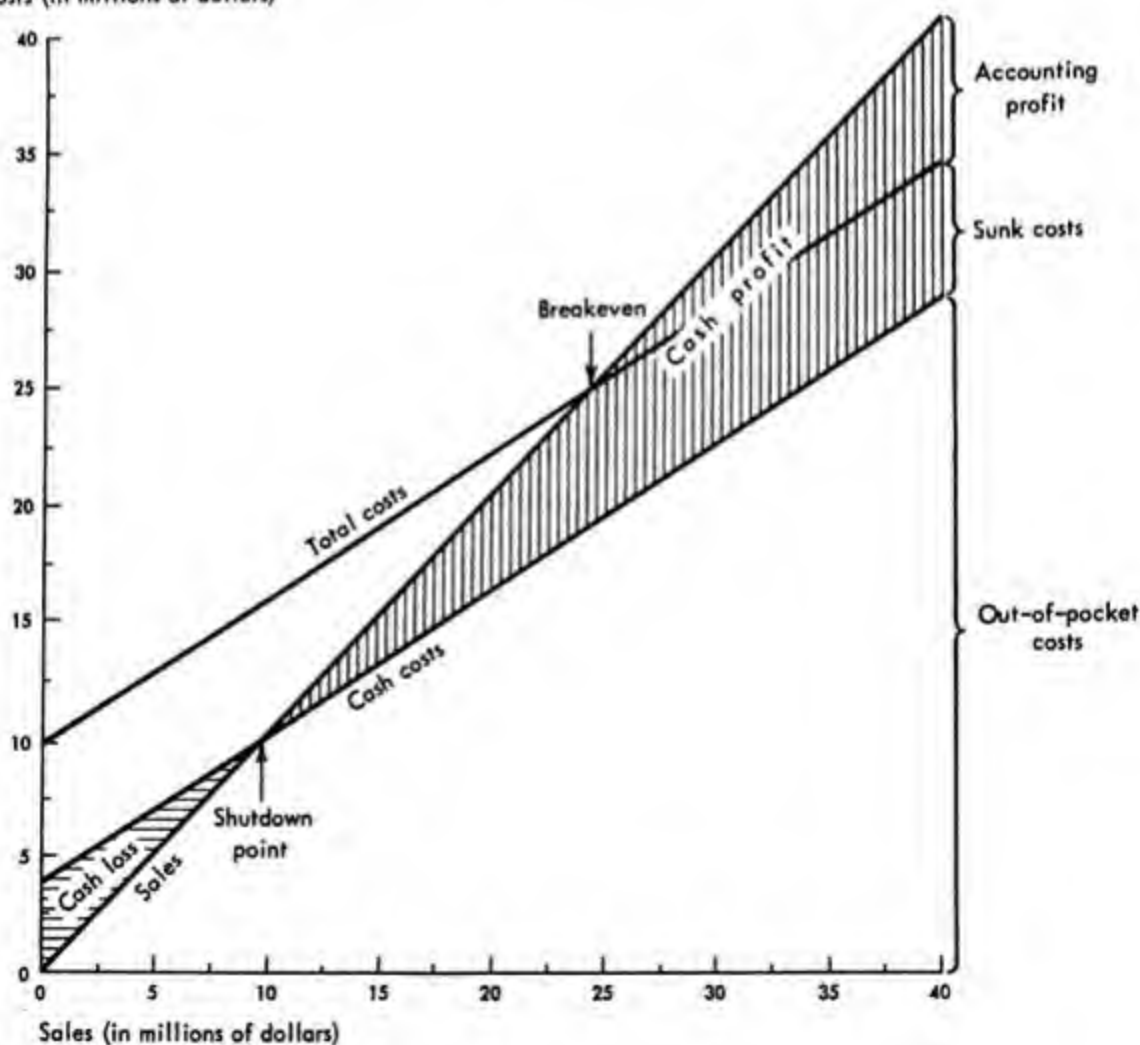


Fig. 12-4 Break-even analysis showing break-even and shutdown points.

volved, as, for example, special start-up costs, including retraining of workers.

If the company were to operate at the \$9 million sales level, variable out-of-pocket costs would be \$5.4 million (i.e., 60 percent of sales), and fixed out-of-pocket costs are \$4 million, resulting in a cash loss of \$400,000.

### **Break-even analysis and plant-expansion decisions**

Break-even charts may be utilized to reveal the effect of an actual or proposed change in operating conditions. This may be illustrated by showing the impact of a proposed plant expansion on costs, volume, and profits. For simplicity, the assumption is made that the relationship between variable costs and sales will not be affected by the proposed change.

The original data contained in Exhibit 12-1 has been adjusted in Fig. 12-5 to show the effect of a contemplated plant expansion. It will be assumed that a market survey has indicated that it should be possible to increase the company's volume to \$50 million sales in a reasonably short period. The proposed plant addition will raise the plant's production capacity from \$40 million to \$60 million in sales but also will increase annual fixed costs by \$2.5 million.

Figure 12-5 reveals that if the expansion is undertaken, the average annual profit, at the expected sales level of \$50 million, will be \$7.5 million, as compared with \$6 million at the present capacity of \$40 million in sales. Moreover, if in the future the plant operates at the potential capacity of \$60 million, the annual profit will rise to \$11.5 million. Actually, in a capital-investment decision of this type, the estimated return on the additional investment must be considered.

### **Break-even analysis and product profitability**

As stated previously, cost-volume-profit analysis is most useful when prepared for lower-level segments of the business where greater homogeneity of data exists. This may be illustrated by assuming that our mythical company produces and sells four distinct lines of products. The cost-volume-profit data for each line, at the company's budget level of \$32.5 million, appear in Exhibit 12-3.

Exhibit 12-3 indicates that variable costs do not vary in the same manner for each of the product lines and that contribution margins differ. Also, fixed costs in the exhibit have not been charged to the product lines on a proportional basis. It generally is incorrect to assume that fixed costs apply ratably to each product line, particularly in a highly diversified company. One product line may use expensive machinery, whereas another may be more dependent on assembly labor.

More accurate product profitability statements occur when fixed costs are identified, to the extent possible, directly with each product line. Depreciation of machinery normally would be a direct fixed cost, whereas

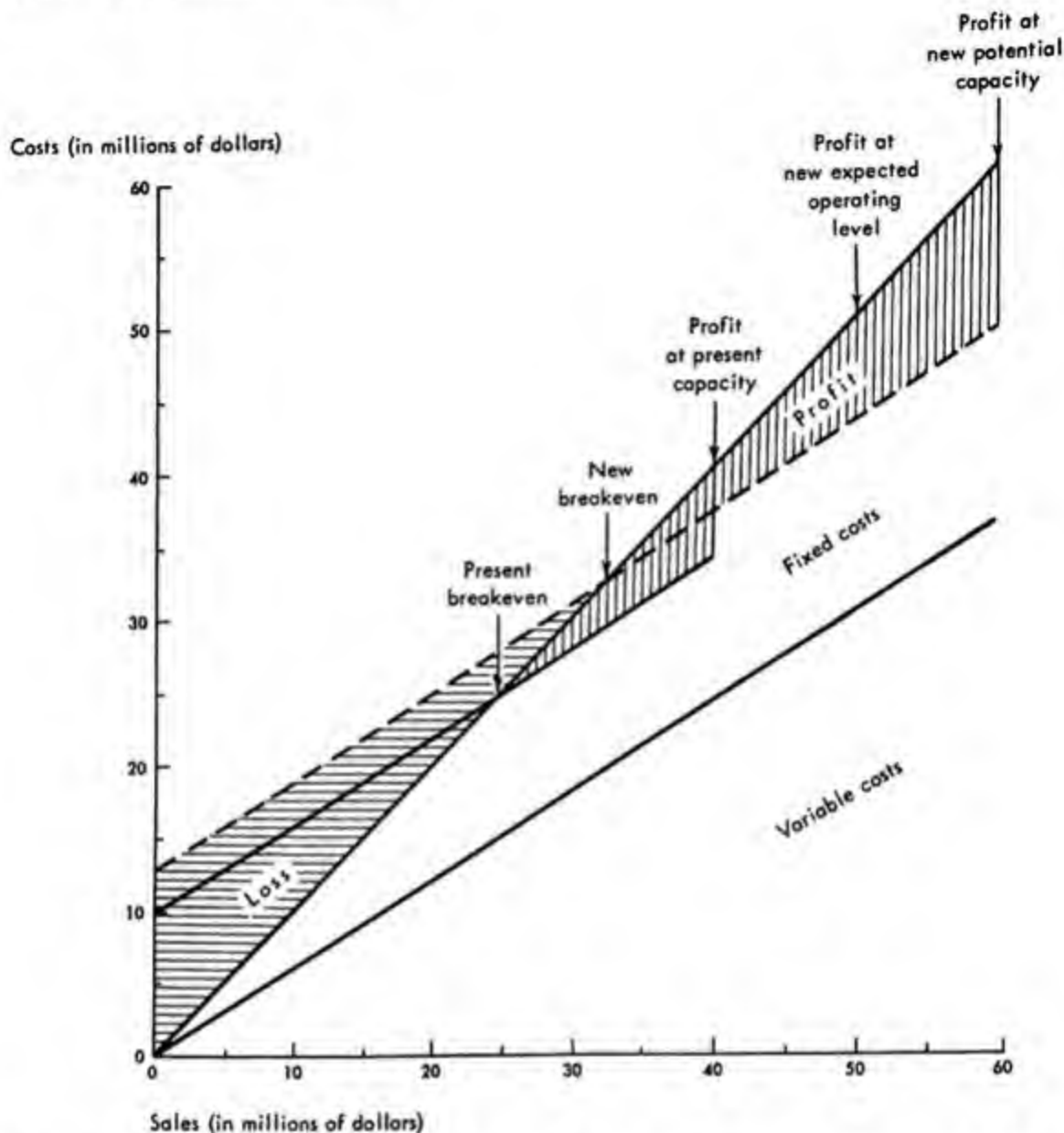


Fig. 12-5 Break-even analysis showing the effect of a proposed expansion of plant capacity.

depreciation of the plant building is an indirect fixed cost of a product line. The profit before allocated fixed costs represents the contribution that each product line makes toward the indirect fixed costs and profit. When this is related to the direct product-line capital investment, we obtain a useful measurement of a product line's long-run profitability.

In order to establish product-line capital investments, one must determine which items of capital investment apply directly to a product line and which require allocation. Generally, inventories, receivables, and machinery can be associated directly with a product line. Cash and general company assets, e.g., factory building, warehousing facilities, have to be allocated to product lines. Both the direct- and indirect-capital

# Exhibit 12-3

## Condensed Forecast of Profit and Loss and Return on Capital Investment By Product Line at Budget Level (In thousands of dollars)

Product line.....	A		B		C		D		Total	
	60 %		85 %		90 %		95 %		80 %	
	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%
Percent of present potential capacity.....										
Sales.....	\$7,000	100.0	\$4,500	100.0	\$12,000	100.0	\$9,000	100.0	\$32,500	100.0
Less: Variable costs.....	3,990	57.0	3,030	67.3	8,160	68.0	4,320	48.0	19,500	60.0
Contribution margin.....	\$3,010	43.0	\$1,470	32.7	\$3,840	32.0	\$4,680	52.0	\$13,000	40.0
Less: Fixed costs directly chargeable to product lines.....	720	10.3	330	7.4	2,420	20.2	1,895	21.0	5,365	16.5
Profit before allocated fixed costs.....	\$2,290	32.7	\$1,140	25.3	\$1,420	11.8	\$2,785	31.0	\$7,635	23.5
Less: Allocated fixed costs.....	890	12.6	770	16.9	1,970	16.4	1,015	11.3	4,635	14.3
Profit before income tax.....	\$1,410	20.1	\$370	8.4	\$ (550)	(4.6)	\$1,770	19.7	\$3,000	9.2
Return on total capital investment.....		53.2		14.7		(8.1)		29.3		16.7
Return of profit before allocated fixed costs on direct-capital investment.....		168.4		139.0		52.6		124.9		107.4

### Product-line capital investment

	A		B		C		D		Total	
	60 %		85 %		90 %		95 %		80 %	
	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%
Direct-capital investment*.....	\$820 + 7.7 %	\$1,360	\$460 + 8 %	\$820	\$1,500 + 10 %	\$2,700	\$1,565 + 7.4 %	\$2,231	\$4,345 + 8.5 %	\$7,108
Allocated capital investment*.....	\$1,080 + 3.0 %	1,290	\$1,555 + 3 %	1,690	\$3,740 + 3 %	4,100	\$3,530 + 3 %	3,800	\$9,905 + 3 %	10,880
Total capital investment at budget level.....		\$2,650		\$2,510		\$6,800		\$6,031		\$17,988

\* Budgeted capital investment consists of a fixed portion and a variable portion, shown as a percentage of sales.



investment can be either fixed, variable, or partly fixed and partly variable.

The data contained in Exhibit 12-3 also may be presented in graphic form as shown in Fig. 12-6. The vertical axis shows the profit or loss for each of the product lines at different sales volumes. The point at which a product line meets the vertical axis, i.e., at 0 sales, represents total fixed costs of that product line. The solid vertical lines indicate the profit or loss for each of the product lines at the budgeted level of operations. The vertical dashed lines reveal the profit or loss at the product line's present capacity. The area between the two represents the lost profit resulting from unused facilities.

Profit or loss (in millions of dollars)

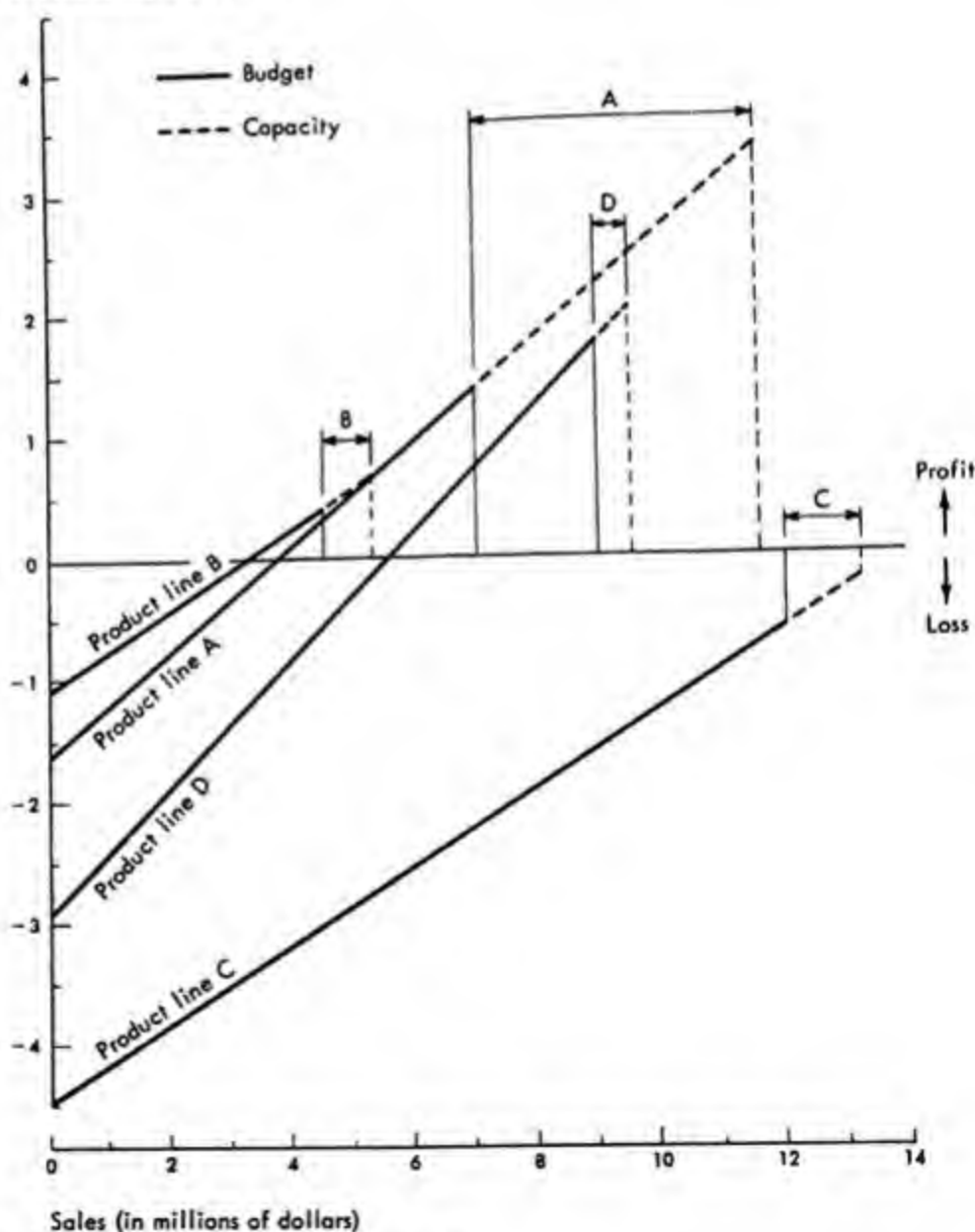


Fig. 12-6 Break-even chart by product line.

- a ——— Return of profit before allocated fixed costs on direct capital  
 b ——— Return of total profits on total capital  
 c ——— Return on sales

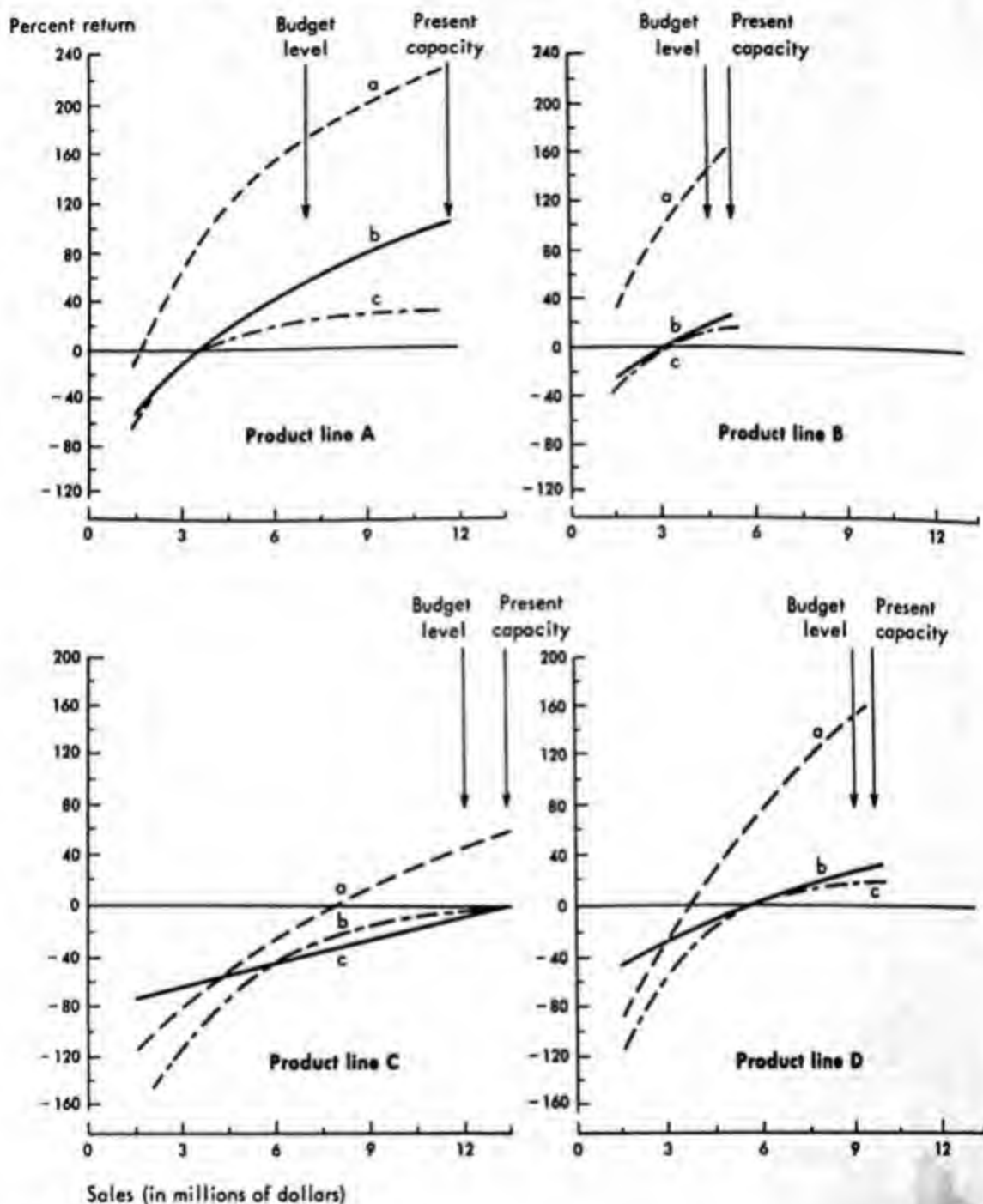


Fig. 12-7 Product-line rates of return.

Which product line is most desirable to "push," in the long run? In the short run? If by short run we refer to the time period during which we can operate without having to replace present facilities, product line D is the most desirable to push. This product line has the sharpest rate of inclination in Fig. 12-6, and thus the highest contribution margin. It will produce the highest short-term cash return. However, it will be noted that product line D already is operating at close to capacity.

In the long run, when it becomes necessary to consider the replacement of existing machinery, product line A is the most attractive, at least on the basis of past performance, since it yields the highest return per dollar of direct-capital investment, as shown in Exhibit 12-3.

Figure 12-7 graphically presents for each of the product lines three important criteria: return of profit (before allocated fixed costs) on direct-capital investment, return of total profit on total capital, and return on sales.

Figure 12-6 reveals that product line C is highly unprofitable. Even if this product line were produced to the point of full capacity (\$13.3 million), it would continue to show an accounting loss. Should product line C therefore be eliminated? As long as the revenue of a product line

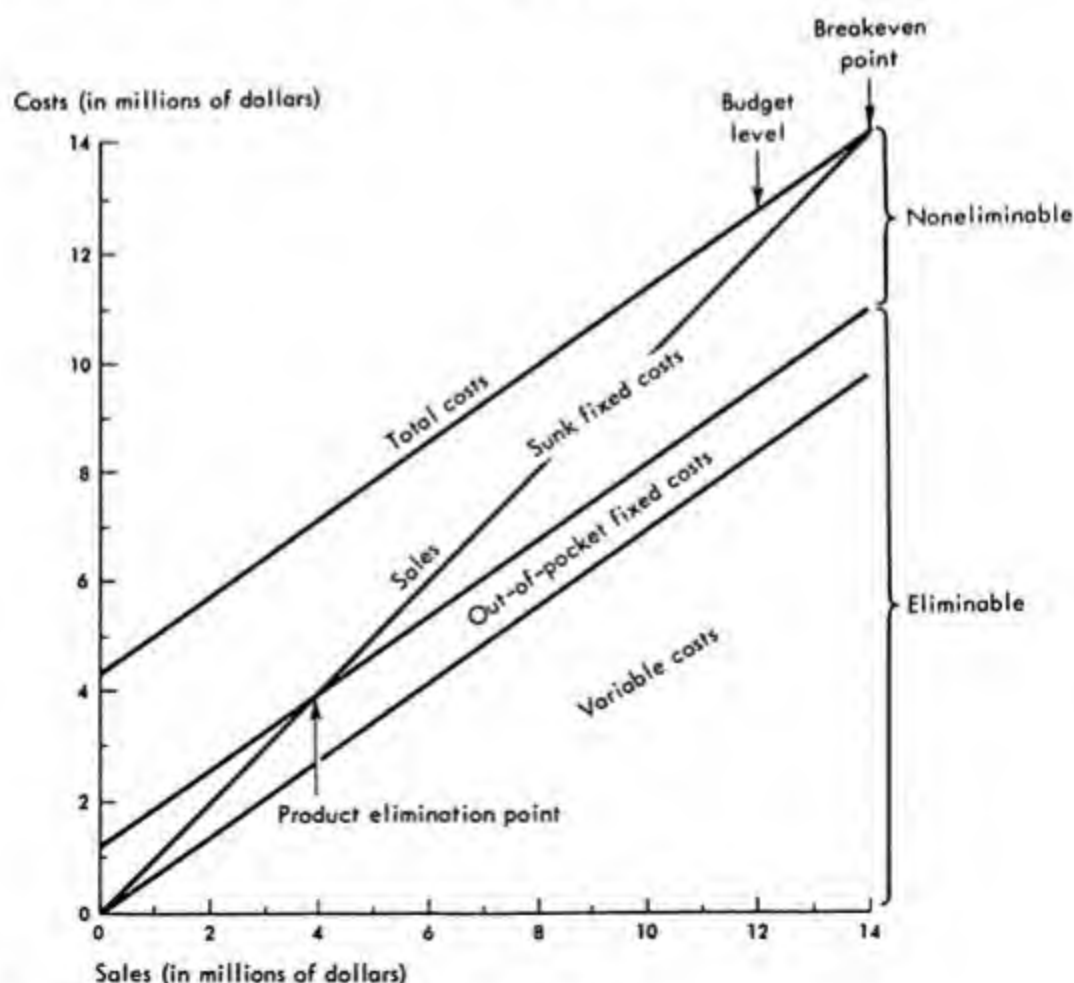


Fig. 12-8 Break-even analysis: product line C.

exceeds its eliminable costs, the product line should be retained, i.e., provided that the space occupied and facilities used cannot be employed more profitably. Eliminable product costs generally include variable costs plus out-of-pocket direct fixed costs, although conceivably dropping a product also will result in the elimination of some allocated fixed costs.

The point of elimination for a product line is equal to:

$$\frac{\text{Eliminable fixed costs}}{1 - (\text{variable costs/sales})}$$

Let us assume that of the \$2.4 million of direct fixed costs applicable to product line C (Exhibit 12-3), \$1.2 million are sunk and \$1.2 million are out-of-pocket costs. Accordingly, product line C should not be eliminated as long as sales of product line C exceed \$1,200,000/.32, or \$3.75 million. This is shown graphically in Fig. 12-8. The considerations involved in eliminating a product line are apt to be more complex in practice and may include profit or loss on sale of assets, tax aspects, and possibilities for improving profitability in the future.

### Break-even analysis and price changes

A change in the price of a product assuming demand is elastic with respect to price, affects the number of units sold, profits, and the break-even point. This may be illustrated by assuming that a company has a single product line and that the present average selling price per unit is \$10. Average variable cost per unit is \$6. The plant's capacity is 20,000 units.

Marginal contribution (in thousands of dollars)

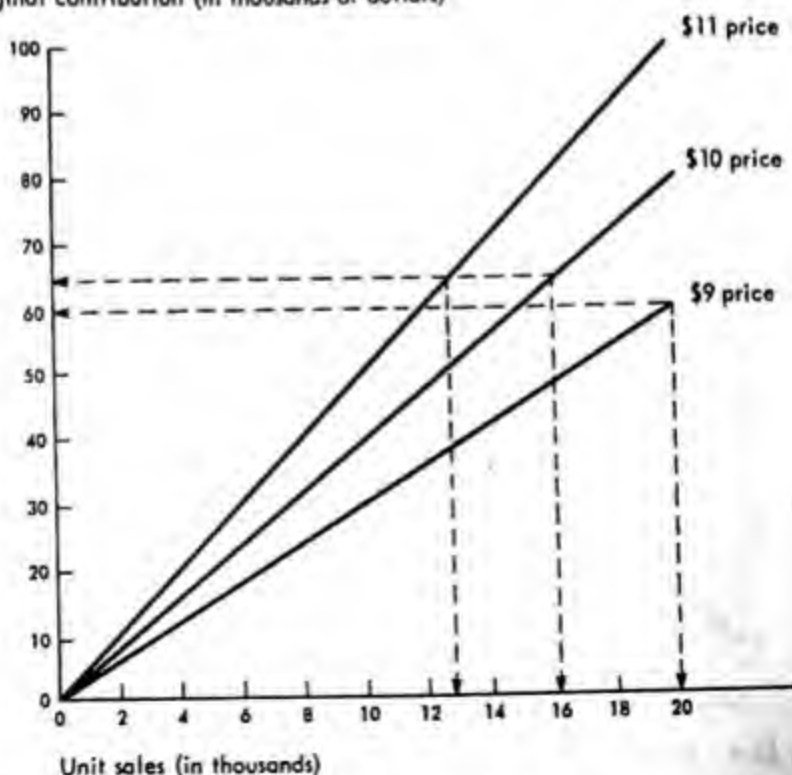


Fig. 12-9 Effect of price changes on profit.

Figure 12-9 shows what the contribution margin will be for different sales levels at the present price and also if the price is raised or lowered 10 percent. The company presently is selling 16,000 units. In order to earn the same profit as at present, with a price rise of 10 percent, only 12,800 units must be sold. If the price is reduced 10 percent, 21,333 units will have to be sold to prevent a decline in profits, below present levels. However, this is in excess of the plant's capacity. If a maximum of 20,000 units were sold at \$9, profits would be reduced by \$4,000 below the current amount.

An increase in price lowers the break-even point, and a decrease in price raises it. The extent of the effect of price revisions on break-even points is affected by the magnitude of the fixed costs. The phenomenon is called *operating leverage*. This effect is shown for the same data by assuming that the fixed costs are, respectively, \$20,000, \$30,000, or \$40,000. If the fixed costs are \$40,000 instead of \$20,000, an increase of only \$20,000, the amount of sales required to break even also is doubled, e.g., from \$60,000 to \$120,000 at a \$9 price.

Break-even points at different sales prices are shown below:

<i>Fixed costs</i>	<i>\$9 price</i>	<i>\$10 price</i>	<i>\$11 price</i>
\$20,000	\$ 60,000	\$ 50,000	\$44,000
30,000	90,000	75,000	66,000
40,000	120,000	100,000	88,000

While this type of analysis is very useful to pricing executives, it assumes that variable unit costs are constant. Actually, certain of the variable expenses such as selling commissions and customer discounts are affected by a price revision. Other variable costs may increase or decrease in a curvilinear rather than a linear fashion.

### Break-even analysis and product mix

Within the range of its plant capacity, a firm may increase the contribution margin and profit and lower the break-even point by improving the mix of products sold, i.e., selling proportionately more of those products having the highest contribution margin ratio. This is illustrated in Fig. 12-10, by assuming the following facts for a company:

	<i>Product A</i>	<i>Product B</i>	<i>Product C</i>
Price.....	\$10	\$12	\$20
Variable costs.....	6	6	12
Contribution margin.....	4	6	8
Fixed costs.....	\$150,000		



Profit or loss (in thousands of dollars)

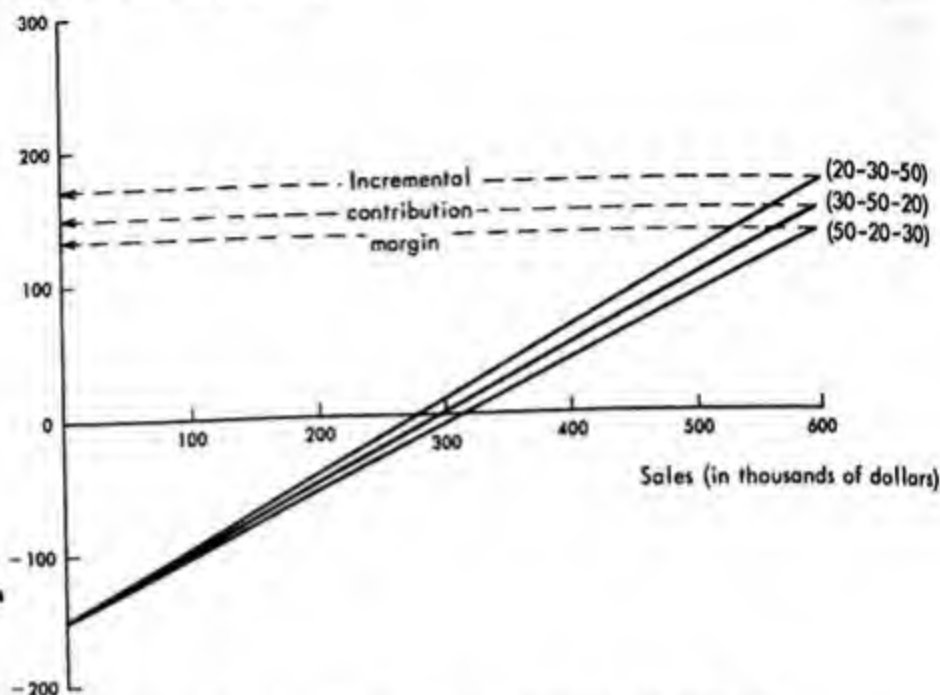


Fig. 12-10 Effect of product mix on break-even point and profits.

In Fig. 12-10, the effect of changing the proportion of total sales represented respectively by products A, B, and C is shown. As the product mix improves, the contribution margin (represented by the dashed lines) and the net profit are increased, and the break-even point is lowered.

## Problems and cases

- 12-1 *Break-even analysis: underlying assumptions.* What assumptions underlie break-even analysis?
- 12-2 *Segregating fixed and variable costs.* What methods may be employed to segregate fixed and variable costs?
- 12-3 *Cost-revenue-profit relationship.* "The relationship between costs, revenue, and profit can be expressed in a linear, curvilinear, or discontinuous manner." What is the meaning of this statement?
- 12-4 *Cost variability and levels of operations.* "The variability of costs is a function of operations." Discuss.
- 12-5 *Types of fixed and variable costs.* Are there different types of fixed and variable costs? How does this affect the use of the data in break-even analysis?
- 12-6 *Static nature of break-even analysis.* "Break-even analysis tends to be static rather than dynamic." Explain.

- 12-7** *Plant versus company use of break-even analysis.* The manager of a product line is receiving a break-even chart which he finds useful in planning his activities. The president of the company, whose products are very diversified, wants to know why he is not being furnished with the same type of planning chart for the company as a whole. How should he be answered?
- 12-8** *Importance of contribution margin.* What is the significance of the contribution margin?
- 12-9** *Break-even analysis: shutdown decision.* Does a break-even chart for a product or a plant indicate the point of elimination or shutdown?
- 12-10** *Economist's and accountant's view of break-even analysis.* What conceptual differences would underlie the break-even analysis of an economist and an accountant?
- 12-11** *Break-even formulas.* Develop the proper formula for each of the following situations.
1. Determining the level of sales required to achieve a given profit
  2. Sales volume needed to offset a reduction in selling price
  3. Sales level at which shutdown should take place
  4. Sales volume required to earn the same profit after a plant expansion (assuming no change in marginal ratio)
  5. Sales volume required to earn same profit as previously, after a plant expansion, and which will provide a stipulated return on the new investment
- 12-12** *Break-even analysis.* X Co. Ltd., a manufacturing concern, has engaged a market research expert to predict future demand for its products. Unfortunately the outlook is not too bright. The directors have asked CA to prepare an analysis showing the extent to which the company could sustain a permanent decrease in operations without recording an operating loss. At present, the operations are at the 100 percent level, and CA obtains the following data based thereon:

Net sales.....	\$2,000,000
Direct materials.....	500,000
Direct labor.....	300,000
Factory service expense—fixed.....	248,500
Factory service expense—variable.....	250,000
Selling expense—fixed.....	50,000
Selling expense—variable.....	200,000
Administration expense—fixed.....	30,000
Administration expense—variable.....	20,000

*Required:*

1. Calculate the sales at the break-even point.
2. Discuss the weaknesses inherent in the preparation and uses of break-even point analysis.

(Chartered Accts—Canada)

- 12-13** *Calculation of selling price; profit and loss projection; break-even analysis.* A client has recently leased manufacturing facilities for production of a new

product. Based on studies made by his staff, the following data have been made available to you:

Estimated annual sales.....	24,000 units	
	<i>Amount</i>	<i>Per unit</i>
Estimated costs:		
Material.....	\$ 96,000	\$4.00
Direct labor.....	14,400	.60
Overhead.....	24,000	1.00
Administrative expense.....	28,800	1.20
Total.....	<u>\$163,200</u>	<u>\$6.80</u>

Selling expenses are expected to be 15 percent of sales, and profit is to amount to \$1.02 per unit.

1. Compute the selling price per unit.
2. Project a profit and loss statement for the year.
3. Compute a break-even point expressed in dollars and in units, assuming that overhead and administrative expenses are fixed but that other costs are fully variable.

(AICPA)

**12-14** *Break-even analysis.* Milton Poeta owns and manages the Paradise Found motel in Miami, Florida. Poeta is a trained electrician and could earn \$12,000 a year, but he prefers to run his own business.

The motel has 50 available rooms, which are rented at \$10 a day. Variable costs of operating the motel amount to \$2 per room rental (per day). Fixed costs per month are as follows: depreciation \$3,000; taxes and insurance \$2,500; maintenance \$1,600; utilities and miscellaneous \$900.

Poeta complains to you that business is very bad from April to September and shows you the following figures.

	<i>Apr.-Sept.</i>	<i>Oct.-Mar.</i>
Potential room rentals.....	9,150	9,100
Rooms rented.....	5,050	8,700
Vacancies.....	4,100	400

*Required:*

1. Based on the foregoing data, prepare a statement showing whether Poeta is making or losing money (broken down by 6-month seasons).
2. What is the number of rooms per month that must be rented to break even?
3. If the room rent were reduced to \$8 during the April-September period, how many rooms would have to be rented per month during this period to break even?
4. Suppose that, regardless of the price per room, it is not possible to cover the fixed costs during July and August. Should the motel be closed down during these months?

**12-15** *Effect of product mix on break-even point.* The J. M. Pratt Company sells three products. Assume that budgeted monthly sales are \$10,000 and that the

proportion of total sales applicable to each product is as follows: A 40 percent; B 50 percent; C 10 percent. The contribution margin of the three products are as follows: A 35 percent; B 20 percent; C 12.5 percent. Monthly fixed costs are budgeted at \$1,200.

*Required:*

1. What will the break-even point be, based on the foregoing data?
2. Suppose that the product mix changes as follows: A 60 percent; B 35 percent; C 5 percent. What will the break-even point be?

12-16

*Break-even analysis with changing factors.* The Soft-Flow Ink Company's income statement for the preceding year is presented below. Except as noted, the cost-revenue relationship for the coming year is expected to follow the same pattern as in the preceding year.

**SOFT-FLOW INK COMPANY**  
Income Statement  
For the Year Ended \_\_\_\_\_

Sales (2,000,000 bottles @ \$.25)	\$500,000
Variable costs	\$300,000
Fixed costs	100,000
Total costs	\$400,000
Pretax profit	\$100,000
Income tax	50,000
Profit after income tax	<u>\$ 50,000</u>

*Required:*

1. What is the break-even point in sales and units?
2. Suppose that a plant expansion will add \$50,000 to fixed costs and increase capacity 60 percent. How many bottles would have to be sold after the addition to break even?
3. What would sales have to be after the plant expansion for the company to maintain its present pretax profit position?
4. The company's management feels that it should earn at least \$10,000 on the new investment. What sales volume is required to enable the company to maintain existing profits and earn the minimum required on the new investment?
5. Suppose that the plant operates at full capacity after the expansion. What profit will be earned?

12-17

*Break-even analysis: change in mix and increased fixed costs.* The following data apply to the Larkin Company:

	Product A	Product B
Budgeted unit sales	10,000	20,000
Selling price	\$10	\$10
Variable costs (% of sales)	50	65
Direct fixed costs	\$18,000	\$12,000
Allocated fixed costs	\$20,000	\$40,000

*Required:*

1. What is the break-even point in sales dollars, and how many units of each product does it represent? Assume the product mix is as budgeted above.
2. How many units of each product must be sold to recover the direct product fixed costs?
3. What would the break-even point in terms of sales dollars be if the product mix were reversed?
4. What would the break-even point be in sales dollars if the indirect costs were increased by \$10,000?

12-18

*Use of break-even analysis in decision making.* The Yearling Company manufactures a single product. Its present plant capacity is 80,000 hours on a single shift basis. An income statement for the past year is presented below.

## THE YEARLING COMPANY

## Income Statement

For the Year Ended \_\_\_\_\_

Sales (500,000 @ \$2).....		\$1,000,000
Costs		
Materials.....	\$200,000	
Direct labor (100,000 hr @ \$2.50)....	250,000	
Overtime premium (20,000 @ \$1.25) ..	25,000	
Other variable costs.....	112,000	587,000
Marginal income.....		\$ 413,000
Less: Fixed costs.....		350,000
Income.....		\$ 63,000

The cost-revenue relationship is expected to remain the same during the coming year. However, the company's sales are expected to increase by 20 percent. The president is concerned about the extensive overtime payments and has inquired of the plant manager whether the company would not be better off to have a second shift. The plant manager points out that a second shift will require an additional supervisor at \$10,000 per year and a shift bonus of 25 cents per hour.

*Required:*

1. Would the company have been better off last year if it had used a second shift?
2. At above what level of plant activity does it pay to start a second shift?
3. Suppose that the company's sales expectations are realized. How much will be saved or lost as a consequence of having a second shift?

12-19

*Break-even analysis in decision to expand plant.* The Cutie Pie Doll and Novelty Company produces a medium-priced line of dolls and plastic toys. All dolls consist of a basic mixture of wood flour, starch, and resin and pass through the same sequence of processing operations. Thus, while the dolls vary in size and styling, the proportion of each cost element to the total cost does not vary significantly. The plastic toys are fabricated by pressing plastic powder in a die. They are then buffed, paint-sprayed, assembled, and packed. The relationship between the different cost elements is approximately the same for the toys.



The company has been successful in recent years and has been operating at full capacity in 1962. This has caused the incurrence of substantial overtime on direct labor. The following statistics were relevant to the year 1962:

	Dolls	Toys
Sales—Amount . . . . .	\$1,200,000	\$900,000
—Units . . . . .	200,000	300,000
Raw materials costs . . . . .	\$350,000	\$270,000
Direct-labor costs . . . . .	\$240,000	\$180,000
Variable factory overhead (% of labor) . . . . .	30.0	33.3
Overtime premium (% of labor) . . . . .	15.0	15.0
Defects (% of total variable factory costs) . . . . .	2.0	.5
Variable selling and administrative costs (% of sales) . . . . .	9.0	7.0
Direct fixed costs . . . . .	\$90,000	\$160,000
Allocated fixed costs . . . . .	\$180,000	\$120,000

In order to meet the growing demand for its products, the company is planning a substantial addition to its plant and equipment. It is estimated that the plant addition would cost \$1,000,000 (50-year life) and the machinery \$300,000 (dolls \$100,000, toys \$200,000 both with 10-year lives). The doll line would require approximately 60 percent of the new space. Additional annual insurance and taxes are estimated at 1 percent of the \$1,300,000 expenditure. It also is believed that with the extra space overtime could be reduced to 5 percent of direct labor. The sales department estimates that with the increased facilities the company could sell 20 percent more dolls and 33½ percent more toys during 1963.

*Required:*

1. Determine the company's profit for 1962, and calculate the break-even point.
2. Estimate the profit for 1963, and calculate the new break-even point. Prices and costs for 1962, unless otherwise indicated, are to extend into 1963. Imputed interest on the new investment is to be ignored.
3. Prepare a break-even chart showing the 1962 total operations and the projection for 1963.

**12-20** *Decision to eliminate a division.* The Creative Chemical Corporation manufactures a variety of chemical products. It also maintains a small detergent division. The detergent division is handicapped by the limited amount of funds appropriated to it. It does not have a balanced line of products or laboratory facilities for product development. It also does not maintain a sales force, relying on distributors for the sale of its products. Despite stable sales, in recent years profits have declined steadily because of rising costs and an inability to increase the selling price. For the year 1962, the division's profit and loss statement is as shown in Exhibit I.

The president of Creative Chemicals is convinced that the detergent division should be eliminated. He points out to the controller that materials costs can be expected to rise 5 percent, or \$5,500, in 1963 and variable factory

*Exhibit I*

## CREATIVE CHEMICAL CORPORATION

Detergent Division

Income Statement

For the Year Ended December 31, 1962

Sales.....		\$310,000
Less: Cost of sales		
Materials.....	\$110,000	
Direct labor.....	100,000	
Factory overhead.....	70,000	280,000
Gross profit.....		\$ 30,000
Less: Selling and administrative expenses.....		12,400
Profit before income taxes.....		<u>\$ 17,600</u>

overhead \$2,000. He also calculates that the annual value of the space to the chemical activities is \$10,000 and interest on the capital investment \$5,000. The president requests the controller to study the situation immediately and report back to him.

Based on an evaluation of all the relevant factors, the controller makes a 5-year projection of costs and revenue, which discloses the following.

1. Sales will continue to remain at \$310,000 a year.
2. Material costs will rise 5 percent in 1963 and again in 1965 and 1967.
3. Direct labor will remain the same in 1963 but will increase 6 percent in 1964 and another 6 percent in 1966.
4. Variable factory overhead amounts to 40 percent of direct labor in 1962. The rate is expected to rise 2 percent each year owing primarily to increasing repair and maintenance costs. Selling and administrative expenses are expected to remain constant during the 5-year period.
5. Fixed factory overhead in 1962 consists of depreciation of plant and facilities \$21,000 and supervision, taxes, and insurance \$9,000. The supervisor's salary is expected to rise \$500 in each successive year.

*Required:* Do you think the detergent division should be eliminated and, if so, when?

- 12-21 *Profit planning and break-even analysis.* The Home Heater Company manufactures three types of heaters, models 100, 200, and 300. Its income statement and product profitability report for 1964 are shown in Exhibits I and II.

In January, 1965, the top management met to plan its sales and production programs for the year. The following conversation took place:

MR. K. (President): "At our last meeting, we agreed that we can expect a 10 percent increase in direct labor and 6 percent in raw materials costs during 1965. Bill, have you figured out how much we can increase our selling prices without losing volume?"

BILL (Sales Manager): "I've talked to our salesmen about this. We think that we can get by with a 3 percent across the board increase and still sell the same number of units. We should be able to sell 1,000 more of model 300 and 2,000 of model 200. However, since we are losing

*Exhibit I*

**THE HOME HEATER COMPANY**  
**Income Statement**  
**For the Year Ended December 31, 1964**

Sales.....		\$1,200,000
Cost of sales:		
Inventories, Jan. 1, 1964.....	\$ 200,000	
Materials.....	270,000	
Direct labor.....	260,000	
Variable factory overhead.....	89,000	
Fixed factory overhead.....	260,000	
Total.....	<u>\$1,079,000</u>	
Less: Inventories, Dec. 31, 1964.....	249,000	830,000
		<u>\$ 370,000</u>
Gross profit.....		
Less: Selling and administrative expenses:		
Variable.....	\$ 62,000	
Fixed.....	204,000	266,000
		<u>\$ 104,000</u>
Pretax profit.....		

*Exhibit II*

**THE HOME HEATER COMPANY**  
**Average Product Prices and Costs**  
**During the Year Ended December 31, 1964**

	<i>Model 100</i>	<i>Model 200</i>	<i>Model 300</i>
Average selling price.....	<u>\$30.00</u>	<u>\$40.00</u>	<u>\$20.00</u>
Factory costs			
Materials.....	\$10.40	\$ 6.00	\$ 5.00
Direct labor.....	6.80	8.00	4.00
Variable factory overhead.....	2.00	3.00	1.00
Direct fixed factory overhead.....	1.60	1.00	1.00
Indirect fixed factory overhead*.....	3.20	8.00	3.00
Total factory costs.....	<u>\$24.00</u>	<u>\$26.00</u>	<u>\$14.00</u>
Gross profit.....	<u>\$ 6.00</u>	<u>\$14.00</u>	<u>\$ 6.00</u>
Less: Selling and administrative expenses			
Direct variable (with sales).....	\$ 1.10	\$ 1.20	\$ .60
Indirect variable (2% of sales).....	.60	.80	.40
Fixed (17% of sales).....	5.10	6.80	3.40
Total selling and administrative.....	<u>\$ 6.80</u>	<u>\$ 8.80</u>	<u>\$ 4.40</u>
Profit margin.....	<u>\$ (.80)</u>	<u>\$ 5.20</u>	<u>\$ 1.60</u>
Number of units sold.....	(10,000)	(20,000)	(5,000)

\* Indirect fixed overhead is allocated to the models on the basis of space occupied by each production line.

## Exhibit III

**THE HOME HEATER COMPANY**  
Rodney's Profit Projection for 1965

Sales (103% of \$1,200,000).....		\$1,236,000
Variable costs:		
Materials (106% of \$270,000).....	\$286,200	
Direct labor (110% of \$260,000).....	286,000	
Variable factory overhead.....	89,000	
Variable selling and administrative		
$\left( \frac{\$62,000}{\$1,200,000} \times \$1,236,000 \right)$ .....	63,860	725,060
Contribution to fixed overhead and profit.....		\$ 510,940
Less: Fixed costs		
Factory.....	\$260,000	
Selling and administrative.....	204,000	464,000
Estimated pretax profit.....		<u>\$ 46,940</u>

$$\text{Break-even} = \frac{\$464,000}{1 - \frac{\$725,060}{\$1,236,000}} = \$1,122,449$$

money on model 100, we are planning to eliminate these models gradually. We are deliberately cutting back sales of model 100 by 3,000 units, even though we could probably sell 4,000 more than last year."

TOM (Production Manager): "Then I better figure that we will produce the same number of units as last year. Model 100 will still take up the same factory space, and we should continue to operate at about 70 percent of capacity."

MR. K.: "Rodney, on this basis can you tell us what we can expect to make next year? Also, we had better take a look at the company break-even to see how much of a safety margin we have just in case we guessed wrong on sales."

RODNEY (Plant Accountant): "After speaking to Bill this morning and getting his estimate on the price increase and sales, I prepared this projection of income for 1965 (Exhibit III)."

MR. K.: "That's almost a \$60,000 drop in profits. Does anyone have an aspirin?"

BILL: "How come you increased my variable expenses but not Tom's?"

RODNEY: "Because yours are based on sales, whereas Tom's are based on production, which will be at the same level as last year."

MR. K.: "What's the story on model 100? Perhaps we ought to eliminate it entirely."

RODNEY: "As you can see by these figures (Exhibit IV), our loss on model 100 will rise from 80 cents per unit to \$1.24, or a total of \$8,680 for the 7,000 heaters."

MR. K.: "Even if we eliminate model 100, we will reduce our loss by only \$8,680. Let's study these figures and meet again later this week."

## Exhibit IV

**THE HOME HEATER COMPANY**  
 Rodney's Projection of the Loss on Model 100  
 For 1965

	<i>Per unit</i>	<i>Total (7,000 units)</i>
Selling price (103 % of \$30).....	<u>\$30.90</u>	<u>\$216,300</u>
Variable costs		
Materials (106 % of \$10.40).....	\$11.02	\$ 77,140
Direct labor (110 % of \$6.80).....	7.48	52,360
Variable factory overhead.....	2.00	14,000
Variable selling and administrative—direct $\left(\frac{\$1.10}{\$30} \times \$30.90\right)$ .....	1.13	7,910
Variable selling and administrative—indirect (2 % of \$30.90).....	.62	4,340
Total variable costs.....	<u>\$22.25</u>	<u>\$155,750</u>
Contribution to fixed costs and profit.....	<u>\$ 8.65</u>	<u>\$ 60,550</u>
Less: Fixed costs		
Factory—direct.....	\$ 1.60	\$ 11,200
Factory—indirect.....	3.20	22,400
Selling and administrative— $\left(\frac{\$204,000}{\$1,236,000} \times \$30.90\right)$ .....	5.09	35,630
Total fixed costs.....	<u>\$ 9.89</u>	<u>\$ 69,230</u>
Loss.....	<u><u>\$(1.24)</u></u>	<u><u>\$ (8,680)</u></u>

$$\text{Break-even} = \frac{\$69,230}{1 - \frac{\$155,750}{\$216,300}} = \$247,300$$

*Required:*

1. Comment on the discussion which took place.
2. Evaluate Rodney's projections.
3. Prepare your own projection of the company's profit for 1965 (assuming you disagree with Rodney's).
4. Prepare a break-even chart for model 100 for 1965, showing the effect of failing to sell an additional 4,000 units and of cutting back sales by 3,000 units. Differences in cost of sales due to changes in opening and closing inventories are to be ignored.



### 13. **Direct, or Variable, Costing<sup>1</sup>**

In the previous chapter, the nature of cost-volume-profit relationships and break-even analysis was described, and the usefulness of this type of data for profit planning, cost control, and decision making was indicated. (Direct, or variable, costing is concerned with "integrating and incorporating into the accounts a group of related techniques which include the flexible (or variable) budget, break-even chart and marginal income analysis."<sup>2</sup> At the present time, direct costing is gaining wider acceptance in practice but still represents an area of controversy.

#### **Direct costing and income measurement**

Under absorption costing, all factory costs are treated as product costs. Factory overhead, inclusive of variable and fixed costs, is applied to items produced at an actual or normal overhead rate. According to this procedure, income is not affected by fixed factory overhead until products are sold (i.e., assuming no under- or overapplied overhead). As products are sold, factory product costs are matched against revenue (less certain period costs) for income determination.

The essential difference between direct costing and absorption costing relates to the treatment of fixed factory overhead. Under direct costing, fixed overhead costs are treated as period costs rather than product costs; that is, they are written off during the period in which they are incurred. Thus, under direct costing fixed factory overhead is excluded from inventories of work in process and finished goods. This can have a substantial effect on the income for the period and the inventory costs shown on the balance sheet.

Although the first written description of direct costing generally is attributed to Jonathan N. Harris,<sup>3</sup> in a broad sense, the concept has a much earlier origin. Direct costing can be traced directly to the marginal

<sup>1</sup> Both terms are used in practice to mean the same thing, although a technical distinction can be made. The term "direct costing" is used in this chapter because this term is used so prevalently in practice.

<sup>2</sup> National Association of Cost Accountants, Committee on Research, "Direct Costing," *NACA Bulletin*, April, 1953, p. 1079.

<sup>3</sup> Jonathan N. Harris, "What Did We Earn Last Month," *NACA Bulletin*, Jan. 15, 1936.

income theory in economics. In fact, in England, direct costing is called "marginal costing." In many European countries, accounting tradition long has countenanced the exclusion of depreciation from product costs. Even in the early development of cost accounting in the United States, a common practice was to attach only prime costs to products manufactured and to treat all factory overhead, variable as well as fixed, as period charges.

Not until factories became more mechanized and the relative importance of factory overhead increased was it considered necessary to assign such costs to products. Even under absorption costing certain factory-overhead costs, such as variances from standard, cost of idle facilities, and excessive or abnormal costs, may be excluded from the cost of products.

In order to show the difference between the two methods, let us assume that a company manufactures a single product selling at \$90 a unit. The plant's normal level of production, which is used as the basis for setting the factory-overhead rate, is 20,000 units. Variable costs per unit are as follows: materials, \$13; direct labor, \$19; factory overhead, \$18; and selling and administrative costs, \$5. Fixed factory costs are \$400,000, and fixed selling and administrative costs are \$60,000. A product cost statement prepared under absorption costing would appear as shown in Exhibit 13-1.

Under direct costing, all variable costs, *including selling and adminis-*

#### Exhibit 13-1

##### Partial Income Statement under Absorption Costing

Selling price.....	<u>\$90</u>
Factory costs:	
Materials.....	\$13
Direct labor.....	19
Variable overhead.....	18
Fixed overhead (\$400,000/20,000 units).....	20
Cost to make.....	<u>\$70</u>
Profit before selling and administrative expenses....	<u>\$20</u>

#### Exhibit 13-2

##### Partial Income Statement under Direct Costing

Selling price.....	<u>\$90</u>
Variable costs:	
Materials.....	\$13
Direct labor.....	19
Variable overhead.....	18
Variable selling and administrative expenses.....	5
Total variable costs.....	<u>\$55</u>
Contribution margin.....	<u>\$35</u>

## Exhibit 13-3

Comparative Effect on Income and Inventories under  
Absorption and Direct Costing

	Period 1		Period 2	
Activity data:				
Production (normal level 20,000), units.....	15,000		20,000	
Sales, units.....	12,000		21,000	
Opening inventory finished goods, units.....	-0-		3,000	
Closing inventory finished goods, units.....	3,000		2,000	
Under full costing:				
Sales.....	12,000 @ \$90	\$1,080,000	21,000 @ \$90	\$1,890,000
Cost of sales.....	12,000 @ \$70	840,000	21,000 @ \$70	1,470,000
Unabsorbed overhead.....		100,000*		-0-
Total cost of sales.....		\$ 940,000		\$1,470,000
Gross profit.....		\$ 140,000		\$ 420,000
Selling and administrative expenses.....		120,000		165,000
Income.....		\$ 20,000		\$ 255,000
Opening inventory.....	-0-		\$210,000	
Closing inventory.....	\$210,000		\$140,000	
Under direct costing:				
Sales.....	12,000 @ \$90	\$1,080,000	21,000 @ \$90	\$1,890,000
Variable costs:				
Materials.....	12,000 @ \$13	\$ 156,000	21,000 @ \$13	\$ 273,000
Direct labor.....	12,000 @ \$19	228,000	21,000 @ \$19	399,000
Variable factory overhead....	12,000 @ \$18	216,000	21,000 @ \$18	378,000
Variable selling and administrative expenses.....	12,000 @ \$5	60,000	21,000 @ \$5	105,000
Total variable costs.....		\$ 660,000		\$1,155,000
Contribution margin.....		\$ 420,000		\$ 735,000
Period costs:				
Fixed factory overhead.....		\$ 400,000		\$ 400,000
Fixed selling and administrative expenses.....		60,000		60,000
Total period costs.....		\$ 460,000		\$ 460,000
Income.....		\$ (40,000)		\$ 275,000
Opening inventory.....	-0-		\$150,000	
Closing inventory.....	\$150,000		\$100,000	

\* Due to operating at the 15,000-unit level instead of the normal level of 20,000 units (5,000 units @ \$20 per unit).

*trative costs*, are deducted from the selling price, resulting in the contribution margin toward fixed costs and profit. For the same product, under direct costing the statement would appear as shown in Exhibit 13-2.

Using the foregoing product cost and revenue data, Exhibit 13-3 compares the effect on income of the two methods based on the activity data shown. To simplify the illustration, it will be assumed that no work in process exists at the beginning and end of the periods.

Exhibit 13-3 shows that income varies substantially under the two methods. This difference is due to costing the finished goods (and work in process) inventories under absorption costing at their full factory cost of \$70, whereas under direct costing they are costed at only their variable factory costs of \$50. Income always will be lower under direct costing when sales lag behind production and a company has accumulated a larger inventory of work in process and finished goods at the end of the period than at the beginning of the period. Under direct costing, profits vary more directly with sales. Under absorption costing, profits are dependent on the level of production as well as sales.

### Period costs versus direct costs

Under absorption costing, a distinction is made between product and period costs. Product costs are those costs which can be identified with, and attached to, products manufactured. Period costs are those which cannot be associated with products and which are written off during the period in which incurred.

Period costs are *defined somewhat differently* under direct costing; i.e., they are the costs of maintaining a given level of capacity to produce and sell. Under direct costing, period costs may be regarded as fixed, or capacity, costs. Thus, period costs are by definition costs which do not vary with changes in volume during the short run. Direct costs, on the other hand, are those costs which are directly responsible for output, within the framework of a stipulated capacity. Direct costs generally are both variable and eliminable; hence, the alternative use of the terms "direct costing" and "variable costing."

In practice, the segregation of specific costs, in this sense, in the classifications of period or direct costs often depends not only on the basic characteristics of a cost but also on management policy and the intended use of the data. If a company's policy is opposed to discharging laborers when output declines, for example, direct-labor cost might be regarded as a period cost rather than a direct cost.

### Merits of direct costing

#### Profit planning ✓

Direct costing focuses attention on contribution margin, which is the excess of sales over variable costs. When expressed as a percentage of

sales, the contribution margin is referred to as the *contribution ratio*, or *marginal ratio*. The contribution ratio is a key figure compiled under direct costing, since it reveals the number of cents that will be available from a dollar of sales to cover fixed costs and profit. This is of considerable importance to managers.

Assuming a fixed capacity to produce and sell, short-run profits are increased or decreased as a consequence of fluctuations in variable costs, changes in selling prices, and shifts in volume and the mix of products sold. Because they fail to distinguish fixed from variable costs and to report them separately, absorption costing and the traditional income statement do not lend themselves to emphasizing this. This may be illustrated by assuming that a company's management received the income statement shown in Exhibit 13-4.

Now let us suppose that management is confronted by the following independent possibilities:

I. The plant is operating at full capacity. It is possible to produce and sell an additional 30,000 units of Y, but only if the production of X is cut back 40,000 units.

**Exhibit 13-4**

**Income Statement under Absorption Costing**

	<i>Product line X</i>	<i>Product line Y</i>	<i>Total</i>
Units sold.....	100,000	200,000	
Price.....	\$5	\$8	
Sales.....	\$500,000	\$1,600,000	\$2,100,000
Less: Cost of sales.....	300,000	1,200,000	1,500,000
Gross profit.....	\$200,000	\$ 400,000	\$ 600,000
Less: Selling and administrative expenses (allocated on the basis of units sold) ..	140,000	280,000	420,000
Profit.....	<u>\$ 60,000</u>	<u>\$ 120,000</u>	<u>\$ 180,000</u>

**Exhibit 13-5**

**Income Statement under Direct Costing**

	<i>Product line X</i>	<i>Product line Y</i>	<i>Total</i>
Units sold.....	100,000	200,000	
Price.....	\$5	\$8	
Sales.....	\$500,000	\$1,600,000	\$2,100,000
Less: Direct costs.....	250,000	640,000	890,000
Contribution margin.....	<u>\$250,000</u>	<u>\$ 960,000</u>	<u>\$1,210,000</u>
Less: Fixed costs.....			1,030,000
Profit.....			<u>\$ 180,000</u>



2. The sales manager estimates that if the price of X is reduced 25 cents, the number of units sold could be increased 20 percent.

3. The company's profit plan for the next period includes forecast sales of 110,000 units of X and 205,000 units of Y. The president desires to know what effect this will have on profits.

The effect on profits of each of these possibilities cannot be determined from the income statement in Exhibit 13-4. Under direct costing, the same data would be reported as shown in Exhibit 13-5.

The effect of each of these alternative possibilities can be rapidly calculated under direct costing, as shown below:

(1) Added contribution of Y (30,000 units @ \$4.80).....	\$ 144,000
Less: Reduced contribution of X (40,000 units @ \$2.50).....	100,000
Net increase in profits.....	<u>\$ 44,000</u>
(2) Sales (120,000 units @ \$4.75).....	\$ 570,000
Less: Direct costs (120,000 units @ \$2.50).....	300,000
Profit contribution.....	<u>\$ 270,000</u>
Present profit contribution.....	250,000
Increase in profits.....	<u>\$ 20,000</u>
(3) Profit contribution:	
X (110,000 units @ \$2.50).....	\$ 275,000
Y (205,000 units @ \$4.80).....	984,000
Total.....	<u>\$1,259,000</u>
Less: Fixed costs.....	1,030,000
Projected profit.....	<u>\$ 229,000</u>
Present profit.....	180,000
Increase in profit.....	<u>\$ 49,000</u>

In the income statement prepared under direct costing, fixed, or period, costs were not allocated to the two product lines. Although period costs often are allocated to product lines or other business segments even under direct costing, such allocations are to a large extent arbitrary and become centers of controversy. However, a distinction should be made between direct and indirect fixed costs. Certain fixed costs, such as depreciation of special facilities, can be identified directly with product lines or other sectors in the firm and should be charged to them, particularly if the data are desired for *long-run* profit planning and decision making.

### Cost control and performance evaluation

Modern cost control utilizes standard costs and variable budgets. No conflict exists between standard costs and direct costing. A standard direct cost system merely would exclude period costs from the product standard costs. In regard to variable budgeting, the basis of this control instrument lies in a careful segregation of fixed and variable costs. This also is the essence of direct costing.

Direct costing tends to provide greater control over period costs than

might occur under absorption costing. In absorption costing, fixed factory overhead is included in the factory-overhead rate, generally through a series of allocations. In this process, it is possible to lose sight of specific controllable period costs and the functional areas to which they apply.

Under direct costing, period costs are accumulated and reported separately, as a deduction from the contribution margin, rather than lumped with cost of sales and inventories. While period costs may not be expected to change within short periods of time, many of these costs are programmed or budgeted in advance, e.g., advertising, research, supervision, and thus are controllable by management.

Direct costing also possesses distinct advantages in evaluating the performance of revenue generating sectors of a firm. In measuring the performance of such sectors, revenue directly earned and costs directly incurred have the greatest relevance.

In order to illustrate this, let us assume that a company manufactures several product lines in a single plant. During the 3 years for which the data are shown, sales of product line A have risen, while those for the other product lines have declined sharply. Fixed factory overhead is allocated to the product lines on the basis of direct-labor dollars, and fixed selling and administrative expenses on the basis of sales. Relevant data for the entire company for three successive years appear below:

	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>
Total company sales.....	\$4,000,000	\$3,200,000	\$2,400,000
Total direct labor.....	\$ 600,000	\$ 500,000	\$ 390,000
Total fixed factory overhead.....	\$ 900,000	\$ 900,000	\$ 897,000
Total fixed selling and administrative expenses.....	\$ 800,000	\$ 800,000	\$ 792,000
Fixed factory overhead rate.....	150%	180%	230%
Fixed selling and administrative rate....	20%	25%	33%

Under absorption costing, based on the above rates for factory overhead and selling and administrative expenses and direct product-line revenue and costs, a statement for product line A would appear as shown in Exhibit 13-6. Apparently, despite increased sales, the profitability of product line A has deteriorated.

As indicated in Exhibit 13-7, a statement for product line A, prepared under direct costing, discloses a noticeable improvement in both contribution margin and the contribution ratio. This occurs because of increased sales at a higher contribution ratio. These are the factors over which the product manager exercises most discretion. The allocated fixed costs are incurred by the firm regardless of the sales activities of the individual product lines. The principles illustrated here apply also to performance evaluation for divisions, plants, sales districts and even individual salesmen.

*Exhibit 13-6*

Profitability Statement—Product Line A  
Under Absorption Costing

	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>
Sales.....	\$1,000,000	\$1,200,000	\$1,400,000
Cost of sales:			
Materials.....	\$ 220,000	\$ 240,000	\$ 270,000
Direct labor.....	150,000	170,000	190,000
Variable overhead.....	30,000	35,000	38,000
Fixed overhead (applied).....	225,000	306,000	437,000
Total.....	\$ 625,000	\$ 751,000	\$ 935,000
Gross profit.....	\$ 375,000	\$ 449,000	\$ 465,000
Less: Selling and administrative expenses			
Variable.....	\$ 100,000	\$ 110,000	\$ 120,000
Fixed (applied).....	200,000	300,000	462,000
Total.....	\$ 300,000	\$ 410,000	\$ 582,000
Net profit.....	\$ 75,000	\$ 39,000	\$ (117,000)
Return on sales.....	7.5%	3.3%	(8.3%)

*Exhibit 13-7*

Profitability Statement—Product Line A  
Under Direct Costing

	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>
Sales.....	\$1,000,000	\$1,200,000	\$1,400,000
Direct costs:			
Materials.....	\$ 220,000	\$ 240,000	\$ 270,000
Direct labor.....	150,000	170,000	190,000
Variable factory overhead.....	30,000	35,000	38,000
Variable selling and administrative expenses.....	100,000	110,000	120,000
Total.....	\$ 500,000	\$ 555,000	\$ 618,000
Contribution margin.....	\$ 500,000	\$ 645,000	\$ 782,000
Contribution ratio.....	50%	53.7%	55.9%

### Decision making

Direct costing produces valuable data for short-term decision making. In short-run decisions, period costs are not relevant. Direct costing avoids the use of overhead rates, which tend to create impressions of exactitude that generally are not warranted. Cost allocations and overhead rates are based on judgments that rarely are precise enough for decisions. Overhead cannot be assumed to apply uniformly to all products or product lines. Some products require more supervision or inspection in their manufacture than others, and this rarely is disclosed by the use of overhead rates.

The establishment of overhead rates requires a predetermination of

the expected level of operations. This is not easy to do. Should the expected operating level be based on plant potential? How many shifts? What consideration should be given to bottlenecks, breakdowns, strikes, etc.? To what extent should the plant operating potential be adjusted for the salability of the products? These questions account for the fact that many executives find it difficult to understand the significance of the under- or overapplied overhead figure.

Direct costing is particularly useful in short-run pricing decisions. Absorption costing emphasizes long-run accounting profits rather than cash profits, which have the greatest relevance in short-term pricing decisions. Product prices which result in losses under absorption costing may show profit increments under direct costing, provided the revenue exceeds the variable costs and better opportunities for the utilization of the facilities do not exist. A more extensive discussion of direct costing and pricing decisions appears in a later chapter.

Direct cost data are useful in capital investment and make or buy decisions. In capital-investment decisions one is interested primarily in projected cash flows and the return yielded on the funds required. In make or buy decisions, a comparison is made between the incremental cost of making and the cost of purchasing. Period costs generally are not relevant in analyses for such decisions. If idle capacity and other resources exist that cannot otherwise be used, their costs are not relevant in make or buy decisions. This may even include direct laborers who are temporarily idle, provided the company's policy is not to discharge such workers. A more detailed discussion of capital-investment and make or buy decisions occurs in subsequent chapters.

Some other short-run decisions which depend on direct cost data are selection among alternative uses of production facilities; selling versus additional processing of manufactured items; optimizing the production mix; determining inventory levels; selective selling; delivery route decisions; and determining the size of the sales force. These and other decisions will be discussed at length in later chapters.

### Income measurement under varying activity levels

As indicated earlier (Exhibit 13-3), income may vary significantly under direct costing as compared with absorption costing. Exhibit 13-8 shows the comparative effect on income where there are changes in the levels of production and sales. The data underlying Exhibit 13-8 are as follows:

Price of product .....	\$100
Variable factory cost per unit .....	\$40
Fixed factory overhead .....	\$200,000
Normal production level .....	10,000 units
Fixed factory costs per unit .....	\$20
Variable selling and administrative costs per unit .....	\$15
Fixed selling and administrative costs .....	\$150,000
Unit cost of beginning inventories assumed to be the same as current unit cost.	



**Exhibit 13-8**

Comparison of Income  
Under Absorption and Direct Costing  
For Varying Levels of Production and Sales  
(Normal factory level: 10,000 units)

Units pro- duced	Income under absorption costing			Income under direct costing		
	Units sold, 4,000	Units sold, 10,000	Units sold, 16,000	Units sold, 4,000	Units, sold 10,000	Units sold, 16,000
4,000	\$(170,000)	\$(20,000)	\$130,000	\$(170,000)	\$100,000	\$370,000
10,000	(50,000)	100,000	250,000	(170,000)	100,000	370,000
16,000	70,000	220,000	370,000	(170,000)	100,000	370,000

The following general conclusions can be drawn from the data presented in Exhibit 13-8:

1. Under direct costing, income is correlated with sales and is not influenced by the level of production.
2. Under absorption costing, income is affected by production as well as sales.
3. Income is the same under both methods when production and sales are equal.
4. When production exceeds sales, income is higher under absorption costing.
5. When sales are greater than production, income is higher under direct costing.

#### Direct costing and accounting theory

The relative merits of absorption and direct costing, as a basis for income measurement, may be viewed (1) from the standpoint of conformance with accepted accounting theory and (2) from the standpoint of the usefulness of the data obtained.

The measurement of income by accountants is based on a matching of revenue and costs. Under absorption costing, the cost of products is matched against the revenue derived from their sale. Accordingly, it is necessary to assign all factory costs, fixed as well as variable, to products manufactured.

Proponents of direct costing view the matching process somewhat differently. Fixed factory-overhead costs, under direct costing, are a cost of the period in which they are incurred, rather than product costs. Only the direct or variable portion of manufacturing costs are treated as product costs and deferred in inventories. This is supported by the argument that period costs are long-run costs which are incurred whether or



not products are manufactured, whereas direct costs are short-term costs which are directly responsible for production in the short run.

Unlike most period costs, direct costs which are deferred in inventories reduce the amount of the next period's expenditures for direct costs. In this connection, the Research Committee of the National Association of Accountants comments as follows:<sup>4</sup>

Short-run costs should include only those costs which tend to be incurred by producing during the period in question and to be avoided by not producing. These are the costs that tend to vary directly and proportionately with volume of production. Those costs which remain the same in total, i.e., the period costs, should be excluded from the short-run unit cost. Short-run costs have the following characteristics which are significant in measuring periodic income:

1. Unit direct or variable cost of production is objectively measurable because the amount of such costs tends to vary directly and proportionately with volume of production. On the other hand the amount of period cost is independent of the volume of production within limits for which capacity provided remains the same. Therefore, period costs can be attached to product units only by making an arbitrary assumption as to the volume of production over which to spread the period costs.

2. Benefits acquired by incurrence of direct costs expire with sale of the related goods. Having once been incurred to produce goods, direct costs need not be incurred again until more goods are produced. In other words, by producing goods in the current period the amount of direct costs which must be incurred in future periods is reduced in proportion to the direct cost of the goods carried forward. For this reason, the direct cost of goods on hand is deferrable as inventory until the benefits expire by the sale of the goods. In contrast, the amount of period cost to be incurred in future periods cannot be reduced by producing goods to be carried forward in inventory, nor can the current period costs be reduced by producing less in the current period.

The arguments supporting direct costing, as the basis of income measurement, are not without merit. Nevertheless, whether absorption costing or direct costing constitutes the superior method for determining income will not be resolved on the basis of existing theoretical considerations alone. Ultimately, the selection between these two methods will hinge on social and practical usefulness. The accountant's present definition of income is not immutable. If the needs of society require an improved form of income measurement, it may be presumed that the accounting profession will take appropriate action.

### *Criticisms of direct costing*

In recent years, there has been widespread interest in direct costing. Nevertheless, only a relatively few business firms, although a growing

<sup>4</sup> *Current Application of Direct Costing*, National Association of Accountants, Research Report 37, New York, 1961, p. 74.

number of them, have adopted this method of accounting. Opposition to direct costing is based on the following criticisms:

1. It is improper to eliminate fixed factory overhead from inventories of work in process and finished goods. The argument that long-run factory capacity exists regardless of short-run levels of production is considered specious. Fixed costs, like variable costs, are incurred in order to manufacture products and therefore should be applied to such products. Opponents of direct costing also contend that the exclusion of fixed factory overhead from inventories constitutes a serious violation of the principle of matching costs against revenue for income determination. According to this interpretation of the matching concept, the more costs that can be attached to products, the more precise income measurement becomes.

Under direct costing, profits increase or decrease with changes in sales. For a firm with highly seasonal sales, direct costing results in periods of excessive losses followed by periods of abnormally high profits. A company that manufactures and stores products for 10 months prior to the Christmas season would show large losses for 10 months and very high profits during the 2-month season. Under such circumstances, it is doubted that monthly income statements prepared under direct costing would be as meaningful as those prepared under absorption costing.

The exclusion of fixed factory overhead from inventories affects the balance sheet as well as the income statement. Opponents of direct costing maintain that this would produce an even more conservative and unrealistic balance sheet than presently is being prepared. They point out that working capital, which is an important guide in short-term credit transactions, would be impaired. Proponents of direct costing, however, argue that the balance sheet does not reflect economic values. They suggest that it is, rather, a statement of costs awaiting assignment against future revenue, plus certain monetary values such as cash, receivables, and marketable securities. Defenders of direct costing also claim that in long-term decisions, creditors and financial analysts look to the earning potential of a company rather than balance sheet data and that in short-term credit transactions, creditors are more concerned with the market value of inventories than with accounting costs.

2. Direct costing undeniably is useful in short-run profit planning and decision making, but in decision making one is interested in special-purpose costs rather than the general variability of costs. Certain "non-accounting" costs often are relevant in decision making, and certain accounting costs are not relevant.

While direct costs are important in short-run pricing decisions, opponents of direct costing point out that direct costing creates a tendency to disregard the need to recover fixed costs through product pricing, since long-run continuity depends on the replacement of assets. In this connection, many companies that use direct costing also allocate fixed factory costs to product lines and other segments of the firm. However,

the allocated costs are shown as a deduction from the contribution margin.

3. Advocates of direct costing have been criticized for oversimplifying the technical difficulties encountered in establishing the variability of costs and the reliability of the data obtained. Variable costs rarely are completely variable, and fixed costs rarely completely fixed.

Moreover, the assumption of linear rather than curvilinear variability is not realistic in practice. There usually are a large number of semi-variable costs which vary in an irregular fashion. Many costs also vary more closely with a base other than sales, as, for example, order size, weight, number of transactions. It must be recognized, therefore, that direct costing does not provide an exact indication of what the contribution margin is at different operating levels.

In this connection, the Committee on Research of the National Association of Accountants stated:<sup>5</sup>

Practice seems to show that precision in the separation of direct and period costs is less important for inventory costing than it is for profit planning and cost control. Borderline costs which cause most of the difficulties in classification are often relatively small in total and can be put into either the direct or period category without material effect on inventory or income margin figures.

### *The attitudes of professional societies toward direct costing*

The stated attitudes of the American Institute of Certified Public Accountants, the American Accounting Association, and the National Accounting Association toward direct costing differ.

The American Institute of Certified Public Accountants has not specifically dealt with direct costing in its accounting research bulletins. However, a general statement, in which acceptable inventory costs are defined, appears in *Accounting Research Bulletin* 43. The statement includes the following sentence: "It should also be recognized that the exclusion of all overheads for inventory costs does not constitute an accepted accounting procedure."<sup>6</sup> Clearly, this does not specifically relate to the exclusion of fixed factory overhead from inventory costs. It is not surprising, therefore, that the comment has been interpreted differently by advocates and opponents of direct costing.

The Committee on Concepts and Standards Underlying Financial Statements of the American Accounting Association has unequivocally rejected direct costing as an acceptable basis for income measurement. In the 1957 "Revision of Accounting and Reporting Standards for Corporate Financial Statements," the committee stated, "... the cost of a

<sup>5</sup> National Association of Cost Accountants, Committee on Research, *op. cit.*, p. 18.

<sup>6</sup> *Accounting Research Bulletin* 43, American Institute of Certified Public Accountants, Committee on Accounting Procedure, New York, 1953, p. 29.

manufactured product is the sum of the acquisition costs reasonably traceable to that product and should include both direct and indirect factors. The omission of any element of manufacturing cost is not acceptable."<sup>7</sup>

Two of the seven members of the committee disagreed with the conclusion of the majority. In their dissent, they concluded that "... direct costing is at least as acceptable in accounting theory as is the conventional (full costing) concept. Moreover, they believe that the use of direct costing procedures will, in many cases, yield results more useful to investors as well as management."<sup>8</sup>

The Research Committee of the National Association of Accountants in Research Report 37 primarily was concerned with reporting the experiences of companies using direct costing. While the National Association of Accountants does not issue judgments on accounting practice, the committee report clearly was favorably inclined toward direct costing.

### *The tax status of direct costing*

The regulations of the Internal Revenue Code do not specifically bar or condone the usage of direct costing. Two general criteria are provided in regard to inventory valuation: "It must conform as nearly as possible to the best accounting practice in the trade or business" and "It must clearly reflect the income for the period."

In the approval of inventory valuations the Internal Revenue Service has been influenced by consistency and the effect on taxable income. The Internal Revenue Service has been reluctant to permit companies to change from absorption to direct costing if the change is accompanied by a decline in taxable income. Cases have occurred in which permission to use direct costing has been informally granted.

If direct costing becomes more acceptable to the accounting profession, possibly either the Internal Revenue Code will be amended to specifically permit the use of direct costing, or the Internal Revenue Service will more positively sanction the use of direct costing. This has occurred in regard to other controversial areas such as the use of Lifo and accelerated depreciation.

### *A compromise approach to direct costing*

Undoubtedly, the greatest area of controversy in regard to direct costing relates to the effect on income measurement. The advantages that can be

<sup>7</sup> American Accounting Association, Committee on Concepts and Standards Underlying Financial Statements, *Accounting Review*, October, 1957, p. 539.

<sup>8</sup> *Ibid.*



*Exhibit 13-9*

Income Statement Combining Direct and Absorption Costing  
(Based on data contained in Exhibit 13-3)

## Period 1:

Sales .....		\$1,080,000
Less: Variable costs		
Materials .....	\$156,000	
Direct labor .....	228,000	
Variable factory overhead .....	216,000	
Variable selling and administrative expenses .....	60,000	660,000
Contribution margin .....		420,000
Less: Period costs		
Fixed factory overhead .....	400,000	
Fixed selling and administrative expenses .....	60,000	460,000
Income before inventory adjustment .....		(40,000)
Add: Portion of period fixed costs deferred in closing inventory .....		60,000
Income .....		<u>\$ 20,000</u>

## Period 2:

Sales .....		\$1,890,000
Less: Variable costs		
Materials .....	\$273,000	
Direct labor .....	399,000	
Variable factory overhead .....	378,000	
Variable selling and administrative expenses .....	105,000	1,155,000
Contribution margin .....		735,000
Less: Period costs		
Fixed factory overhead .....	400,000	
Fixed selling and administrative expenses .....	60,000	460,000
Income before inventory adjustment .....		275,000
Add: Portion of period fixed costs deferred in closing inventory .....		
inventory .....	40,000	
Less: Portion of prior period's fixed costs absorbed in products sold this period .....	(60,000)	(20,000)
Income .....		<u>\$ 255,000</u>

derived internally from the use of direct costs, for planning, controlling, and decision making, are considerably less controversial. These advantages may be gained without altering present standards for determining income but merely by changing the *form* of the income statement.

An example of this modified approach appears in Exhibit 13-9, using the same data which appeared in Exhibit 13-3. It will be noted that the "Income before inventory adjustment" is identical with that produced under direct costing but that the final income after adjustment for the fixed factory overhead included in inventories is identical to that produced under absorption costing.



*Problems and cases*

- 13-1 *Period and product costs.* Is the distinction between period and product costs the same under direct and absorption costing?
- 13-2 *Direct and absorption costing: variations in production and sales.* What generalizations can you make as to the effect on income of variations in production and sales, under the two methods of costing?
- 13-3 *Direct costing and decision making.* "Direct costing provides management with more useful data for decision making." Do you agree? If so, indicate in what type of decisions direct costing could be useful.
- 13-4 *Short- and long-run decisions.* Why is direct costing more useful in short-run decisions? Does it tend to be equally useful in long-run decisions?
- 13-5 *Income measurement under alternative costing methods.* Write a one-page statement indicating why you think direct costing or absorption costing provides a better basis for measuring income for external reporting purposes.
- 13-6 *Direct and absorption costing in highly seasonal business.* Would direct or absorption costing provide more useful interim income data for a highly seasonal business?
- 13-7 *Direct costing: compromise approach.* Is there any way to utilize the advantages of direct costing for internal purposes and yet conform to presently existing standards for external reporting?
- 13-8 *Direct costing: break-even analysis and budgeting.* What relationship exists between direct costing, break-even analysis, and budgeting?
- 13-9 *Limitations of predetermined overhead rates.* Under direct costing, the use of predetermined overhead rates is avoided. What disadvantages are there to the use of predetermined overhead rates?
- 13-10 *Direct and absorption costing: level of operations.* A company using absorption costing decided that in order to reduce unit costs, it was necessary to continue to operate at a very high level of output, even if inventories were piling up. Might the use of direct costing have led to a different conclusion?
- 13-11 *Direct and absorption costing: product cost statements.* Which type of product cost statement, one prepared under direct costing or one prepared under absorption costing, would better enable the sales manager to determine which products to "push" next year?
- 13-12 *Direct costing in make or buy decisions.* How might direct costing be useful in make or buy decisions?
- 13-13 *Absorption and direct costing and fixed costs.* "Under absorption costing, management loses sight of the importance of fixed costs." Comment.
- 13-14 *Direct costing: absence of volume variance.* "Under direct costing, no volume variance is calculated, and management is not told what the cost of unused capacity is." Comment.
- 13-15 *Direct costing: advantages and disadvantages.* Supporters of direct costing have contended that it provides management with more useful accounting

information. Critics of direct costing believe that its negative features outweigh its contributions.

*Required:*

1. Describe direct costing. How does it differ from conventional costing?
2. List the arguments for and against the use of direct costing.
3. Indicate how each of the following conditions would affect the amounts of net profit reported under conventional absorption costing and direct costing:
  - a. Sales and production are in balance at standard volume.
  - b. Sales exceed production.
  - c. Production exceeds sales.

(AICPA)

**13-16** *Internal accounting and reporting under direct costing and external reporting under absorption costing.* The Dircost Company manufactures a single product and uses a direct cost system for recording the transactions and for internal reporting, on an FIFO basis. Only variable factory costs are charged to Work in Process and Finished Goods. The variable overhead rate used by the company is 50 cents per hour. The Overhead Budget Variance is closed out at the end of the year to Cost of Sales. For external reporting, closing inventories are adjusted for fixed factory overhead at \$7.50 per unit. This adjustment is not recorded in the company's accounts. Based on the transactions listed, record all debits and credits to the accounts shown. (Ignore offsetting entries to accounts not shown.)

Raw Materials	Work in Process	Finished Goods
12/31/63 50,000	-0-	12/31/63 (10,000 units) 120,000
Variable Factory Overhead Control	Variable Factory Overhead Applied	Overhead Budget Variance
-0-	-0-	-0-
Fixed Factory Overhead	Variable Selling and Administrative Expenses	Fixed Selling and Administrative Expenses
-0-	-0-	-0-
Cost of Sales	Sales	Profit and Loss
-0-	-0-	-0-

*Transactions:*

1. Raw materials purchased.....	\$510,000
2. Raw materials used.....	506,000
3. Direct labor (300,000 hr @ \$2.25).....	675,000
4. Factory overhead incurred:	
Variable.....	170,000
Fixed.....	780,000
5. Selling and administrative expenses incurred:	
Variable.....	70,000
Fixed.....	160,000
6. In process on Dec. 31, 1964, 20,000 units fully completed as to materials and $\frac{1}{2}$ completed as to labor and overhead	
7. Transferred to finished goods, 90,000 units	
8. Sold, 85,000 units @ \$26	

*Required:*

- Record the transaction in the accounts given, and prepare an income statement for both internal and external reporting purposes.
- Account for the difference in income under the two methods.

13-17

*Direct and absorption costing: profit planning and income measurement.* Flear Company has a maximum productive capacity of 210,000 units per year. Normal capacity is regarded as 180,000 units per year. Standard variable manufacturing costs are \$11 per unit. Fixed factory overhead is \$360,000 per year. Variable selling expenses are \$3 per unit, and fixed selling expenses are \$252,000 per year. The unit sales price is \$20.

The operating results for 1961 are: sales, 150,000 units; production, 160,000 units; beginning inventory, 10,000 units; and net unfavorable variance for standard variable manufacturing costs, \$40,000. All variances are written off as additions to (or deductions from) standard cost of sales.

*Required:* (For items 1, 2, and 3 assume no variances from standards for manufacturing costs.)

- What is the break-even point expressed in *dollar sales*?
- How many *units* must be sold to earn a net income of \$60,000 per year?
- How many *units* must be sold to earn a net income of 10 percent on sales?
- Prepare formal income statements for 1961 under:
  - Conventional costing
  - "Direct" costing
- Briefly account for the difference in net income between the two income statements.

(AICPA)

13-18

*Income under direct and absorption costing: stable production and seasonal sales.* The Clifton Company manufactures Christmas-tree lights. The standard cost per unit is shown below.

Materials.....	\$ .30
Direct labor.....	.20
Variable factory overhead.....	.10
Fixed factory overhead.....	.40
Total.....	\$1.00

Operating data during each of the four quarters of a particular year were as follows:

	1st quarter	2d quarter	3d quarter	4th quarter
Sales (@ \$1.25 a unit), units	40,000	50,000	80,000	430,000
Production	140,000	140,000	140,000	140,000
Actual materials cost per unit	\$ .31	\$ .30	\$ .32	\$ .31
Actual labor cost per unit	\$ .20	\$ .22	\$ .21	\$ .20
Variable factory overhead	\$15,000	\$16,000	\$13,000	\$14,000
Fixed factory overhead	\$57,000	\$57,000	\$58,000	\$58,000
Fixed selling and administrative expenses	\$15,000	\$15,000	\$15,000	\$15,000
Variable selling and administrative expenses	\$ 2,000	\$ 2,500	\$ 4,000	\$21,500

At the beginning of the year, there were 50,000 units of finished goods on hand. Inventories in process are to be ignored. Variances are to be written off to cost of sales as incurred. Materials price and usage variances are taken at the time materials are used.

*Required:*

1. Determine the income for each quarter under absorption and direct costing.
2. Account for the difference in income under the two methods.

### 13-19

*Direct and absorption costing: fluctuating production and sales.* During the latter part of 1963 a new company was formed to manufacture and distribute a newly developed cigarette lighter called the Vu Lite. The company's management is interested to know what income will be reported if they use direct or absorption costing. Based on market surveys and customer commitments, the following forecast data have been prepared for 1964.

	1st quarter	2d quarter	3d quarter	4th quarter
Production	40,000	50,000	50,000	60,000
Sales	30,000	40,000	50,000	80,000
Materials	\$24,400	\$33,000	\$32,000	\$36,000
Direct labor	\$16,000	\$22,000	\$22,000	\$24,600
Variable overhead	\$ 8,200	\$10,000	\$10,800	\$12,800
Fixed overhead	\$30,000	\$30,600	\$30,800	\$30,800
Variable selling and administrative expenses	\$ 8,400	\$10,200	\$10,400	\$12,600
Fixed selling and administrative expenses	\$16,000	\$16,000	\$16,500	\$16,200

The sales price of the lighter has been established at \$3 per unit. The company uses an *Fifo* method for costing inventories. Inventories of work in process are to be ignored. Closing inventories of finished goods are to be costed at actual cost of materials and direct labor and applied overhead. Over- or underapplied overhead is to be closed out to cost of sales at the end of each quarter. The budgeted quarterly level of production for purposes of setting



predetermined overhead rate is 50,000 units. Budgeted quarterly fixed costs are \$30,000 and variable costs 20 cents per unit.

*Required:*

1. Based on the forecast data, prepare income statements for each quarter under both direct and absorption costing methods.
2. Account for the differences in income.
3. What general conclusions can you form regarding income under the two methods at different levels of production and sales?

**13-20** *Income under direct and absorption costing.* Western Liquors, Inc., produces a single product, Old Hutch. Its normal operating level for purposes of overhead absorption is 18,000 cases a year. Operating statistics during 1963 were as follows:

Production.....	20,000 cases
Sales.....	16,000 cases
Selling price.....	\$30 per case
Inventory, Jan. 1, 1963.....	3,000 cases
Inventory, Dec. 31, 1963.....	7,000 cases
Materials cost per case.....	\$7
Labor cost per case.....	\$6
Variable overhead cost per case.....	\$4
Fixed overhead costs.....	\$108,000
Variable selling and administrative costs.....	10% sales
Fixed selling and administrative costs.....	\$50,000

While costs were the same in 1963 as in 1962, in 1964 materials costs rose 10 percent and labor costs 5 percent. All other costs remained unchanged. Despite a rise in selling price of 4 percent in 1964, 4,000 additional cases were sold. However, production declined in 1964 by 3,000 cases. The company uses first-in, first-out for costing its inventories.

*Required:* Prepare income statements for 1963 and 1964 under absorption and direct cost accounting and a statement which combines both methods.

**13-21** *Direct costing and decision making.* The Stick Rite Glue Company sells glue to stationery stores throughout the country at 25 cents per unit. The company's condensed income statement is presented below.

**STICK RITE GLUE COMPANY**  
Condensed Income Statement  
For the Year Ended December 31, 1964

Sales.....	\$750,000
Less: Variable costs (per unit).....	450,000
Contribution margin.....	\$300,000
Less: Fixed costs.....	250,000
Income.....	<u>\$ 50,000</u>

The company is planning to expand its plant and facilities. The cost of the planned expansion is estimated at \$350,000, which consists of a plant addition at \$250,000 (50-year life) and machinery at \$100,000 (10-year lives).

*Required:*

1. The president wants to know how many additional units will have to be sold to provide the present profit plus \$35,000 a year on the new invest-



ment. All data are to be assumed to remain unchanged except for those specifically related to the expansion.

2. The president also inquires how many units must be sold, if the expansion is undertaken and the price is reduced to 22 cents per unit, in order to earn the stipulated profit.

**13-22** *The use of contribution margin in decision making.* The Grand Union Railroad Company maintains a freight and passenger rail service covering a distance of approximately 100 miles. For many years, the company has failed to earn a satisfactory return on the invested capital. Recently, a new management has been appointed by the board of directors.

The new president is convinced that the poor earnings record can primarily be attributed to the steady decline over the years in passenger revenues. Passenger revenues are derived from commuters located around a large city at the southern terminus of the line. Monthly commutation fares average \$25 per passenger. As a consequence of the decline in passengers, scheduled trains have been sharply curtailed. However, there now are indications that the lack of parking facilities and congested highways might turn prospective passengers back to the railroad if additional trains were scheduled.

Three possibilities are under consideration in regard to the passenger service.

1. Increase the number of scheduled trains so that additional passengers will find it attractive to travel by train instead of car.
2. Petition the state regulatory commission for an increase in passenger rates.
3. Abandon the passenger service.

A management consulting firm has been employed to survey the market and make recommendations. Its survey indicates the following:

1. That if the number of scheduled trains were increased 50 percent, without changing the commutation fare, a 40 percent increase in total passengers could be anticipated within a reasonably short period of time. If the additional trains are scheduled and commutation fares are increased 10 percent, the number of passengers could be expected to increase 20 percent.

2. If present commutation rates were increased 10 percent, without scheduling additional trains, there would be a 5 percent decline in the number of passengers.

3. If passenger service were abandoned, there would be a reduction in local taxes of \$100,000 in addition to the elimination of direct costs.

An income statement for the past year is presented below:

**THE GRAND UNION RAILROAD COMPANY**  
Income Statement  
For the Year Ended \_\_\_\_\_

	<i>Passenger</i>	<i>Freight</i>	<i>Total</i>
Revenues.....	<u>\$2,500,000</u>	<u>\$17,500,000</u>	<u>\$20,000,000</u>
Variable costs:			
Salaries—train crews.....	\$ 250,000	\$ 800,000	\$ 1,050,000
Fuel.....	500,000	3,200,000	3,700,000
Maintenance and repairs.....	400,000	2,000,000	2,400,000
Supplies and miscellaneous.....	100,000	300,000	400,000
Total variable costs.....	<u>\$1,250,000</u>	<u>\$ 6,300,000</u>	<u>\$ 7,550,000</u>

## DIRECT, OR VARIABLE, COSTING

Direct fixed costs:			
Depreciation—depots and platforms	\$ 100,000	\$ 680,000	\$ 780,000
Personnel—depots and platforms	160,000	150,000	310,000
Other location costs	80,000	70,000	150,000
Depreciation—rolling stock	350,000	2,100,000	2,450,000
Total direct fixed costs	<u>\$ 690,000</u>	<u>\$ 3,000,000</u>	<u>\$ 3,690,000</u>
Indirect fixed costs:			
Depreciation—rails, switches, etc.	\$ 360,000	\$ 2,900,000	\$ 3,260,000
Depreciation—miscellaneous facilities	130,000	800,000	930,000
Interest	140,000	1,000,000	1,140,000
Administrative costs	220,000	1,300,000	1,520,000
Local taxes	250,000	1,500,000	1,750,000
Total indirect fixed costs	<u>\$1,100,000</u>	<u>\$ 7,500,000</u>	<u>\$ 8,600,000</u>
Total costs	<u>\$3,040,000</u>	<u>\$16,800,000</u>	<u>\$19,840,000</u>
Income	<u>\$ (540,000)</u>	<u>\$ 700,000</u>	<u>\$ 160,000</u>

*Required:* Apart from tax and other considerations, which of the alternatives presented appears most desirable? A distinction should be made between the short and the long run.

**13-23** *Variable costs and decision making.* The Manning Chemical Company manufactures five different products from a single raw material. The raw material has been scarce, and at present the company has only 10,000 pounds on hand (cost \$15,000) and is uncertain as to when additional materials will be delivered. The labor rate is \$2 per hour for all products. The factory overhead rate also is \$2 per hour (\$1.40 fixed and 60 cents variable). The selling commission is 10 percent of the product price.

With the following data as basis, you are to indicate to which products the raw materials on hand should be applied so as to maximize profits and what the maximum profits will be.

Product	Market demand, units	Selling price	Labor hours required	Pound of X per unit of finished product
I	4,000	\$ 8.00	1.0	.7
II	3,600	7.50	.8	.5
III	4,500	12.00	1.5	1.4
IV	6,000	9.00	1.1	1.3
V	5,000	11.00	1.4	1.5

- 13-24 *Direct costing: product-line evaluation.* The Alhambra Company produces a number of products that are classified according to product lines. Each product line has a manager in control of its activities. Profitability statements are prepared at the close of each year, and managers receive a bonus based on the percentage improvement over the past year in the product line's return on sales. Al Jones was most disgruntled when he received the following report on his product line:

Product-line Profitability Statement  
1964 in Comparison with 1963

	1964	1963
Sales.....	\$600,000	\$500,000
Cost of sales:		
Materials.....	\$120,000	\$110,000
Direct labor.....	85,000	75,000
Variable factory overhead.....	17,500	15,000
Fixed factory overhead—applied.....	153,000	112,500
Total.....	\$375,500	\$312,500
Gross profit.....	\$224,500	\$187,500
Less: Selling and administrative expenses		
Variable.....	\$ 55,000	\$ 50,000
Fixed—allocated.....	150,000	100,000
Total.....	\$205,000	\$150,000
Income.....	\$ 19,500	\$ 37,500

*Required:* Do you think Al Jones is justified? If so, what kind of report would you prepare?

- 13-25 *Direct and absorption costing: performance evaluation.* The Ace Hardware Manufacturing Company produces and distributes a varied line of hardware. The following territorial profitability statement was submitted to the sales manager as the basis for evaluating territory performance.

**ACE HARDWARE COMPANY**  
**Territory Income Statement**  
**For the Year Ended December 31, 1964**

	<i>Territory 1</i>	<i>Territory 2</i>	<i>Territory 3</i>	<i>Total</i>
Revenues				
Sales.....	\$1,290,000	\$1,397,500	\$1,612,500	\$4,300,000
Allocated interest and dividends.....	15,000	16,250	18,750	50,000
Total revenues.....	<u>\$1,305,000</u>	<u>\$1,413,750</u>	<u>\$1,631,250</u>	<u>\$4,350,000</u>
Cost of sales—at standard....	\$ 720,000	\$ 845,000	\$1,050,000	\$2,615,000
Add: Factory variances....	69,000	80,750	100,250	250,000
Total cost of sales.....	<u>\$ 789,000</u>	<u>\$ 925,750</u>	<u>\$1,150,250</u>	<u>\$2,865,000</u>
Gross profit.....	<u>\$ 516,000</u>	<u>\$ 488,000</u>	<u>\$ 481,000</u>	<u>\$1,485,000</u>
Less: Selling and administrative expenses				
Selling salaries.....	\$ 80,000	\$ 90,000	\$ 105,000	\$ 275,000
Other direct selling expenses	75,000	70,000	85,000	230,000
Direct advertising and sales promotion expenses.....	50,000	55,000	75,000	180,000
Territory office expenses....	65,000	72,000	80,000	217,000
Territory warehousing.....	40,000	60,000	65,000	165,000
Home-office sales management.....	18,000	19,500	22,500	60,000
Home-office administrative expenses.....	48,000	52,000	60,000	160,000
Total.....	<u>\$ 376,000</u>	<u>\$ 418,500</u>	<u>\$ 492,500</u>	<u>\$1,287,000</u>
Income.....	<u>\$ 140,000</u>	<u>\$ 69,500</u>	<u>\$ (11,500)</u>	<u>\$ 198,000</u>

**Required:**

1. Which territory manager had the best over-all performance during the year?
2. Which territory manager exercised the best control over territory expenses?
3. Which territory manager sold the most profitable product mix?
4. Does it pay to continue to maintain territory 3?
5. What other information is needed to answer these questions intelligently?
6. Using the data given, can you prepare a more useful type of report?

**13-26** *Direct and absorption costing in profit planning and decision-making.* Household Snow Plows, Inc., manufactures and distributes two types of snow plows for home use, under the brand names of Plugger Boy and Snow Sweep. Its fiscal year ends on March 31, at the close of its highly seasonal business. Its income statement for the first and second halves of the year ended March 31, 1962, appears in Exhibit I.

**Exhibit I**

**HOUSEHOLD SNOW PLOWS, INC.**

**Income Statement**

**For the Year Ended March 31, 1962**

	<i>1st half, Apr. 1-Sept. 30</i>			<i>2d half, Oct. 1-Mar. 31</i>			<i>Entire year</i>		
	<i>Pluggers</i>	<i>Snow</i>	<i>Total</i>	<i>Pluggers</i>	<i>Snow</i>	<i>Total</i>	<i>Pluggers</i>	<i>Snow</i>	<i>Total</i>
	<i>Boy</i>	<i>Sweep</i>		<i>Boy</i>	<i>Sweep</i>		<i>Boy</i>	<i>Sweep</i>	
Sales	\$ 270,000	\$ 87,500	\$ 357,500	\$ 5,130,000	\$ 2,412,500	\$ 7,542,500	\$ 5,400,000	\$ 2,500,000	\$ 7,900,000
Cost of sales:									
Materials	\$ 60,000	\$ 21,000	\$ 81,000	\$ 1,140,000	\$ 579,000	\$ 1,719,000	\$ 1,200,000	\$ 600,000	\$ 1,800,000
Direct labor	45,000	14,000	59,000	855,000	386,000	1,241,000	900,000	400,000	1,300,000
Factory overhead	90,000	25,200	115,200	1,710,000	694,800	2,404,800	1,800,000	720,000	2,520,000
Total	\$ 195,000	\$ 60,200	\$ 255,200	\$ 3,705,000	\$ 1,659,800	\$ 5,364,800	\$ 3,900,000	\$ 1,720,000	\$ 5,620,000
(Over-) or under-									
sorbed overhead*	\$ (70,000)	\$ (31,500)	\$ (101,500)	\$ 70,000	\$ 31,500	\$ 101,500	-0-	-0-	-0-
Total cost of sales	\$ 125,000	\$ 28,700	\$ 153,700	\$ 3,775,000	\$ 1,691,300	\$ 5,466,300	\$ 3,900,000	\$ 1,720,000	\$ 5,620,000
Gross profit	145,000	58,800	203,800	1,355,000	721,200	2,076,200	1,500,000	780,000	2,280,000
Less: Selling and administrative expenses	418,500	203,500	622,000	661,500	296,500	958,000	1,080,000	500,000	1,580,000
Pretax profit or (loss)	\$ (273,500)	\$ (144,700)	\$ (418,200)	\$ 693,500	\$ 424,700	\$ 1,118,200	\$ 420,000	\$ 280,000	\$ 700,000
Units produced and sold:									
Production	18,000	6,000		14,000	4,500		32,000	10,500	
Sales	1,500	350		28,500	9,650		30,000	10,000	
Units in finished goods—end of period†	16,500	5,650		2,000	500		2,000	500	

\* Assume that this relates only to fixed overhead.

† Assume no opening inventory as of Apr. 1, 1961.



On a miserable Monday morning in April, 1962, Robert Collins, the comptroller, received the following interoffice memo from Mr. Hutchinson, the president.

### *Exhibit II*

## HOUSEHOLD SNOW PLOWS, INC. Interoffice Memo

From: J. P. Hutchinson  
To: Robert Collins

As you know, I have been rather critical of all the money you are spending on the preparation of monthly, quarterly, and semiannual income statements. They just don't seem to provide the type of information I need to solve our problems.

Last month, you mentioned something about direct costing. While I didn't grasp all that you said, I had the feeling that we should explore this further. I have called a meeting for next Friday afternoon with Cal (production manager) and Sam (sales manager). At the meeting, I would like you to discuss the advantages and disadvantages of this direct costing system. Let's not talk in abstractions—prepare whatever schedules you need to illustrate your points. Also, let us know what the effect will be on reported income, taxes, and the balance sheet. In order to help you prepare this material, let me be more specific:

1. It seems to me that, when sales are 21 times greater during the second half, we should have a wider difference between first and second half profits. I also don't understand why fixed factory-overhead costs are included in inventories but fixed selling and administrative costs are excluded.

2. Why can't I tell approximately how much money we will make during the coming year on the basis of our sales forecast and production program? Suppose we guessed wrong on sales by 15 percent, what will this do to profits?

3. It looks as if we are going to have to accede to the union's demand for a 10 percent increase in direct labor. I don't see how we can increase prices and retain our share of the market. What impact will the raise have on profits?

4. Sam says he can make a deal with the Fancil Chain of Canada. They are willing to take 3,000 Plugger Boys and 1,000 Snow Sweeps during the 1st half of this year. They will pay the freight. However, they want a whopping 40 percent price reduction to cover transportation, storage costs, and a quantity discount. Cal figures that this would reduce our labor turnover costs by \$30,000. Even so, using the product cost data which you furnished him, Sam says we would lose \$58,000.

5. Sam says that the product cost data you furnish him contains allocated costs but that he doesn't know how much they are and that this limits his opportunities to increase sales by shaving the price.

6. Every time I get Al Powers on the carpet for his performance on the West Coast, he says his profits are below the company's average only because he is being "socked" with excessive home-office loading charges.

*Exhibit III*

**HOUSEHOLD SNOW PLOWS, INC.**  
**Sales and Production Forecasts**  
**For the Year Ended March 31, 1963**

	<i>1st half</i>	<i>2d half</i>	<i>Total</i>
Sales:			
Plugger Boy.....	1,500	30,500	32,000
Snow Sweep.....	350	10,650	11,000
Production:			
Plugger Boy.....	18,000	14,000	32,000
Snow Sweep.....	6,000	4,500	10,500

*Exhibit IV*

**HOUSEHOLD SNOW PLOWS, INC.**  
**Sales Manager's Calculation of Loss on Fancil Offer**

	<i>Plugger Boy</i>	<i>Snow Sweep</i>	<i>Total</i>
Potential unit sales.....	3,000	1,000	
Net price, after 40% discount.....	\$108	\$150	
Incremental sales.....	<u>\$324,000</u>	<u>\$150,000</u>	<u>\$474,000</u>
Cost to make (Exhibit V).....	<u>\$390,000</u>	<u>\$172,000</u>	<u>\$562,000</u>
Less: Saving on labor turnover*.....			30,000
Incremental costs.....			<u>\$532,000</u>
Incremental loss.....			<u>\$ 58,000</u>

\* Since all selling and administrative costs are excluded from the calculation, the savings in shipping costs were omitted.

*Exhibit V*HOUSEHOLD SNOW PLOWS, INC.  
Product Cost Data

	<i>Under present system (absorption costing)</i>	
	<i>Plugger Boy</i>	<i>Snow Sweep</i>
Selling price.....	<u>\$180</u>	<u>\$250</u>
Costs to make and sell:		
Materials.....	\$ 40	\$ 60
Direct labor.....	30	40
Factory overhead*	60	72
Cost to make.....	<u>\$130</u>	<u>\$172</u>
Selling and administration.....	36	50
Cost to make and sell.....	<u>\$166</u>	<u>\$222</u>
Profit margin.....	<u>\$ 14</u>	<u>\$ 28</u>

	<i>Under direct costing</i>	
Selling price.....	<u>\$180</u>	<u>\$250</u>
Variable costs:		
Materials.....	\$ 40	\$ 60
Direct labor.....	30	40
Variable overhead.....	25	30
Variable selling and administration.....	9	10
Total variable costs.....	<u>\$104</u>	<u>\$140</u>
Contribution to fixed costs and profit.....	<u>\$ 76</u>	<u>\$110</u>
Less: Fixed costs		
Factory overhead.....	\$ 35	\$ 42
Selling and administration.....	27	40
Total fixed costs.....	<u>\$ 62</u>	<u>\$ 82</u>
Profit margin.....	<u>\$ 14</u>	<u>\$ 28</u>

\* Overhead rates are based on the relationship between direct labor and overhead for the year.

$$\text{Plugger Boy } \frac{\$ 900,000}{\$1,800,000}; \text{ Snow Sweep } \frac{\$400,000}{\$720,000}$$

*Required:*

1. Prepare the income statement for Household Snow Plows, Inc., for the year ended March 31, 1962, on a direct cost basis (work in process is to be ignored).
2. Reconcile differences in income and inventories with the data appearing in Exhibit I.
3. Recalculate the profit or loss on the Fancil order on a direct cost basis.
4. Prepare a break-even chart for the coming year, based on the data disclosed.
5. Comment on the president's letter.

## **14. Performance Evaluation and Intracompany Transfer Pricing**

The use of accounting data to measure performance is discussed throughout this book. In this chapter, some of the various threads are drawn together to provide a fuller understanding of the concepts underlying performance evaluation and the use of accounting criteria in such measurements. Because of its importance, special consideration will be given to the subject of intracompany transfer pricing.

### *Performance evaluation*

#### **Objectives of performance evaluation**

The aims of performance evaluation may be listed as follows:

1. To determine the extent to which management's assigned responsibilities have been realized
2. To identify the causes of deviations from established performance standards
3. To suggest courses of action to rectify out-of-control situations
4. To provide motivation for improvement in performance
5. To establish a basis for comparisons between different sectors in a company

#### **Objectives, plans, and performance standards**

The establishment of well-defined company objectives, or goals, is a fundamental requisite of modern management. General company objectives often are expressed in the form of policy statements relating to such areas as profitability, dividends to stockholders, market growth, pricing, employee morale, and efficient use of capital employed. At lower operating levels, the objectives are more limited. For example, getting reports out on time may be an objective of a plant accountant. All plans are formulated and activities undertaken within the framework of these

objectives. A causal relationship exists between plans (means) and objectives (goals).

For each business activity undertaken, management has some expectation as to results attainable. These expectations may be explicit or implicit, clear or vague, reasonable or unreasonable, but they must be presumed to exist. When management's expectations of a business activity or project have been specified, generally in quantitative form, they constitute a plan. A plan, then, is a predetermined course of action. Since planning entails a selection between different courses of action, decision making is an integral aspect of planning.

There are different types of plans, as, for example, short-range, long-range, single, and standing plans. Profit plans, capital-investment budgets, and cash flow projections are examples of plans. A plan may be supported by subplans. Thus, material, labor, and overhead budgets support the profit plan. A plan should be realistic and therefore should be revised as conditions change. Assisting management in the development of plans, quantifying the plans, revising the plans, and providing an effective system for reporting deviations from plans are among the most important responsibilities of the managerial accountant.

Performance standards are indices for measuring the effectiveness of the results of business activities. They provide a basis for comparing actual with planned performance. Since activities emanate from a plan, the plan itself constitutes a form of performance standard. However, an important distinction often exists between a plan and standards for measuring operating performance. A plan reflects the means and expectations of achieving a stipulated goal during a specified time period. A performance standard may be attainable, but there *may be no expectation of its realization* during a particular period of time. Thus, expected variances from labor standards, which are used to measure factory performance, may be "built into" a company's profit plan.

These expected variances, or profit "leakages," may be due to temporary conditions such as learning time required for employees to reach peak performance, change in supervisory personnel, or quality of materials presently available. For purposes of measuring performance, the engineered time standards would not be changed to reflect these conditions, since they represent temporary inefficiencies that are eliminable. Nevertheless, these expected variances should be incorporated into the profit plan, or management will not be provided with a realistic instrument for planning.

In actual practice, *budgets* (plans) also often are reviewed and revised on a monthly or quarterly basis, whereas *standards* for measuring operating performance are revised less frequently. Although the literature of business management has not generally stressed this distinction, at least one writer has referred to it as follows:<sup>1</sup> "When budgets are re-

<sup>1</sup> William Travers Jerome III, *Executive Control—the Catalyst* (New York: John Wiley & Sons, Inc., 1961), p. 34.



garded as 'planning,' it is questionable whether they should be used to compel compliance. Thus, the score envisioned by a golfer on the first tee is not the same as what he intends to set for his bets."

In this book, a distinction will be made between a plan and a performance standard. However, it should be remembered that a plan also represents an index for measuring performance.

In practice, precise yardsticks for measuring the results of an activity often are difficult to establish. A single activity may encompass several different objectives, and a combination of performance standards may be required. The supervisor of a factory department is expected to attain a high level of productive efficiency, maintain the quality of the product, minimize expenses, recommend desirable capital investments, and maintain satisfactory relations with employees.

Many objectives are extremely difficult to measure in quantitative terms. How does one determine the objectives and evaluate the services rendered by a research center or tax department? Often it is difficult to distinguish between qualitative and quantitative aspects of the services performed. For instance, one clerk may bill invoices more rapidly than another but have a higher error rate.

A common and particularly difficult problem arises when the responsibility for an activity is shared by two or more individuals or functions. Labor inefficiency may be due to excessive machine breakdowns (maintenance function), inferior materials (purchasing function), defective materials (inspection function), or poor caliber of personnel (personnel

### *Exhibit 14-1*

#### Illustrative List of Company Objectives and Indices of Planned Performance

<i>Objective</i>	<i>Indices of planned performance</i>
Profitability	Profit plan, budgeted return on sales, marginal contribution
Stockholder satisfaction	Budgeted return on stockholders' investment, planned dividends
Efficient use of capital	Budgeted return on capital employed, budgeted turnover of capital
Corporate liquidity	Budgeted working capital
Minimization of inventory investment	Budgeted inventories
Expense minimization	Variable expense budget
Labor efficiency	Standard labor hours, standard reject allowances
Efficient utilization of materials	Materials usage standards, quality control
Market growth	Budgeted share of market
Employee morale	Labor turnover ratios
Optimum product mix	Budgeted product mix
Minimization of credit losses	Bad debts as a percentage of sales

function). Establishing standards of performance is not a simple task. At the very least, it depends on a clear definition of objectives and responsibilities, the delegation of authority, the use of satisfactory standards, effective communication, and an understanding of the psychology of human motivation.

The interrelationship between objectives and indices of planned performance is illustrated in Exhibit 14-1.

### *Accounting measures and performance standards*

Accounting data are indispensable in performance evaluation, since they measure results in monetary terms which are related to the financial goals of the company. However, other data of a nonaccounting nature also are important. Statistical control charts, labor turnover rates, growth trends, market potentials, and productivity data are examples of non-accounting data that are used in performance evaluation. The four most commonly used accounting measures are (1) internal profitability, (2) standard costs, (3) variable budgets, and (4) return on capital employed. Despite their usefulness, each of these criteria has certain limitations.

#### **Internal profitability**

There are several reasons for calculating the profit of an internal sector of a company. Profit provides an important measure of the efficiency of operations. It represents a basis for evaluating the performance of the executive responsible for the activities of a sector. Profitability may be used for comparing the results of different internal sectors. Internal profit statements disclose areas of weakness and suggest possibilities for profit improvement.

Profit by itself has only limited significance. In order to be meaningful, profit should be related to another index, such as profits of prior periods, budgeted profit, sales, or capital employed. Comparative profit data are valid only if the data have been prepared on a basis consistent with the index with which it is being compared. If changes have taken place in accounting procedures which materially affect the comparability of the results, either the data should be adjusted or the nature and effect of these changes disclosed.

Internal profitability statements generally are most meaningful at the division or plant level where sales are made to outsiders. This does not preclude internal profit reporting at the department level. However, at the department level, it becomes necessary to establish theoretical billing prices for the services or items produced.

Billing prices may be established by referring to comparable external prices for the same services or products. A machine shop might charge the producing departments that it is servicing at rates comparable to that

of other shops in the area. A producing department conceivably might charge market price to departments to which goods are transferred.

In practice, however, profits rarely are calculated below the division and plant level. There are several reasons for this: First, comparable prices generally are not available. Even if market prices do exist, they have to be adjusted, since the manufacturing and selling problems of an independent concern are quite different from those of a department within a company. Second, an internal department is provided with many company services. These service costs would have to be evaluated carefully and allocated to departments in terms of what they might be if the department were independent. Third, the products or services of an internal department are keyed to the demand for the company's end products. As an independent operation, a department's level of activity would be dependent upon its own sales effort. This might result in operating at a totally different level from that of the company as a whole. Fourth, if an internal department were independent, it might be necessary to have a wider line of products in order to meet competition. This introduces manufacturing and distribution problems difficult to evaluate. Because of these complexities, the quantitative criteria used to evaluate performance at the department level generally are standard costs and variable expense budget allowances rather than internal profitability measures.

Problems also are encountered in preparing profit statements for divisions and plants. Even at these levels, it is common to have intracompany transfers. The various ramifications of intracompany transfer pricing warrants special attention and will be discussed later in this chapter.

Determination of division profits is complicated by the existence of different concepts of profit. The selection of an appropriate internal profit index primarily depends upon management's objectives, e.g., long-run performance evaluation, short-run effectiveness, cost control. In the discussion which follows, three profit concepts are recognized: (1) net profit, (2) direct profit, and (3) marginal profit. In each case, in order to avoid discussing the problem of intracompany transfers at this point, let us assume that we are dealing with a division which sells all its products to outsiders.

**Net profit.** When this profit concept is used, the income of a division includes both direct and allocated revenue and costs. The direct and allocated items are segregated, however. This is illustrated in Exhibit 14-2.

This procedure assures that the total of the profits reported for the different divisions will equal the profit appearing on the company's income statement. Proponents of this method claim that since a division receives services from the company, it should be charged for such services. From the standpoint of performance evaluation, however, the inclusion of indirect-profit elements is undesirable. A business sector can best be evaluated in terms of the sector's direct-profit contribution, since

*Exhibit 14-2*Division Income Statement  
Net Profit Basis

Sales.....		\$1,000,000
Less: Cost of sales.....		650,000
		<u>\$ 350,000</u>
Gross profit.....		
Less: Selling and administrative expenses directly applicable to division.....	\$120,000	
Allocated selling and administrative expenses.....	<u>160,000</u>	280,000
		<u>\$ 70,000</u>
		10,000
Less: Allocated financial charges.....		<u>\$ 60,000</u>
Add: Allocated interest and dividends on company securities and investments.....		8,000
Division net profit.....		<u><u>\$ 68,000</u></u>

it exercises little or no control over allocated revenue and costs. Allocations also are a source of controversy, since they frequently are arbitrary.

**Direct profit.** Under this method, a division is given credit only for revenue generated by it and charged only with costs that are directly attributable to it. This does not mean that all central administrative and selling costs are excluded. Certain of these costs, such as advertising and research costs, are incurred specifically for a division and are chargeable to it. This method is illustrated in Exhibit 14-3.

The use of the term "direct profit" should not be confused with direct costing. Direct costing is a marginal cost or variable cost approach to profit determination, whereas direct-profit measurement is concerned with direct versus indirect, or allocated, costs. Under direct costing, fixed factory overhead is omitted from inventories, for example, whereas when direct division profit is calculated, fixed factory overhead is included in inventories.

The advantage of this method is that the direct profit consists of revenue and costs which are largely controllable by the division. The principal disadvantage is its failure to segregate fixed and variable costs. In

*Exhibit 14-3*Division Income Statement  
Direct-profit Basis

Sales.....	\$1,000,000
Less: Cost of sales.....	650,000
	<u>\$ 350,000</u>
Gross profit.....	
Less: Division selling and administrative expenses.....	<u>120,000</u>
Division direct profit.....	<u><u>\$ 230,000</u></u>



**Exhibit 14-4**

**Division Income Statement  
Marginal Profit Basis**

Sales .....	\$1,000,000
Less: Variable factory, selling, and administrative expenses .....	500,000
Contribution margin .....	\$ 500,000
Less: Direct fixed costs .....	270,000
Division direct profit .....	<u>\$ 230,000</u>

the long run, even the direct fixed costs may be regarded as controllable. However, in short-run planning and performance evaluation the fixed costs, whether sunk or out-of-pocket, are unavoidable. Management's concern in the short run is primarily with the variable costs and the contribution margin to cover fixed costs.

**Marginal profit.** Under this method, the total variable costs directly applicable to a division are deducted from sales, resulting in the division's contribution margin. The direct fixed costs are then subtracted from the contribution margin to show the division's direct profit. This is illustrated in Exhibit 14-4.

This form of internal profit statement is similar to that prepared under the direct-profit method in that it includes only revenue and costs directly applicable to a division, i.e., controllable profit elements. The only difference lies in the segregation of fixed and variable costs on the marginal profit statement. However, this is an important difference, since the contribution margin is a key index in short-run planning, decision making, and performance evaluation. Moreover, since direct fixed costs are reported on the marginal profit statement, this method also provides a measure of long-run direct profitability. In general, this type of internal profit reporting is the most useful for management purposes.

### Standard costs

The nature and advantages of standard costs have been described in earlier chapters. Standard costs are an important tool for evaluating performance. However, they also have limitations. Much judgment enters into the establishment of standards, and the same degree of tightness or looseness in standards cannot be expected to occur throughout an organization.

Sometimes standards tend to be somewhat rigid and are not revised frequently enough to give effect to changing operating conditions. Standards are not widely used in areas other than manufacturing. Variance analysis often is complicated by difficulty in determining the number of units produced as a consequence of partially completed items still in process. Variances may be controllable, partly controllable, or uncontrollable, and it is not always easy to fix responsibility even for controllable variances.



### Variable budgets

The principles underlying a variable expense budget have been discussed earlier. Clearly, from the standpoint of performance evaluation, a budget has little significance unless the budgeted expenses have been adjusted to the actual level of operations. While the variable budget is an important instrument of cost control, it also has certain limitations.

First, the variability of expenses rarely can be precisely predicted. In practice, few companies rely even on mathematical techniques for predetermining the variability of expenses.<sup>2</sup>

Second, expense budgeting is based on long-run trend analysis, which may not coincide with the short-run incurrence of expenses. Thus, while machine repairs may conform to the budgeted pattern for the entire year, they may deviate from the pattern sharply during any particular month. This, together with the inability to predict precisely the variability of expenses, tends to lessen somewhat the value of the variable budget for short-term, e.g., monthly, expense control.

Third, the variable expense budget generally includes both controllable and noncontrollable expense elements. The quantities of supplies used normally is controllable by a department supervisor. However, he has little control over the prices paid by the purchasing department for these supplies. A department head may be responsible for the number of hours worked by indirect laborers but have little control over their rate of pay. This can be overcome through the use of standard supply prices and standard rates for indirect labor and by separating the controllable and uncontrollable variances. In practice, few companies attempt to do this.

### Return on capital employed

Erroneous impressions regarding the performance of a division can occur if reliance is placed entirely upon profitability and the capital employed to obtain these profits is ignored. One division may require a proportionately higher investment in cash, inventories, receivables, and fixed assets than another. This is particularly apt to take place in a highly diversified company.

Return on capital employed also bears a direct relationship to the ultimate goal of a corporation, namely, to maximize the return on stockholders' investment. There has been an increasing interest in the use of this criterion for internal measurements during the past decade. Accordingly, a comprehensive treatment of the subject appears in the next chapter.

Despite their usefulness, accounting performance measures—internal profitability, standard costs, variable budgets, return on capital employed—are not perfect forms of measurement. An awareness of the limitations as well as advantages of accounting controls is essential to their intelli-

<sup>2</sup> Current Application of Direct Costing, National Association of Accountants, Research Report 37, New York, 1961, p. 20.

gent use. Overcoming the shortcomings of these accounting indices of internal measurement represents a real challenge to managerial accountants.

### Profit planning and control

The profit plan, or operating budget, is a coordinated program for achieving certain profit objectives within a specified period of time. It is one of the most important tools available to a business concern for planning and coordinating its activities. The very existence of a profit plan compels all levels of management to plan for the future in an organized and systematic fashion. The profit plan focuses attention on centers of responsibility. It integrates all sectors of the firm with the objectives established by top management.

As indicated earlier in this chapter, a distinction should be made between the profit plan and standards for measuring operating performance. Assuming that cost standards, variable expense budgets, sales potentials, and budgeted return on capital employed have been established on the basis of an attainable good level of performance, they represent the real indices for appraising operating performance. However, in order for the profit plan to be a realistic document, recognition should be given to expected variances from these standards.

These variances, which are built into the profit plan, may occur for a variety of reasons. Certain plants or departments may not be expected to operate at standard during a particular profit plan period. Some selling districts may not be expected to achieve their budgeted share of the market. Idle facilities may result in an expected volume variance. Anticipated labor rate and raw materials price variances also may be included in the profit plan.

A *profit improvement plan* is designed to restore out-of-control situations by eliminating actual or expected deviations from performance standards. A profit improvement plan consists of a series of specific projects designed to increase sales, reduce costs, improve product mix, or minimize capital employed. The interrelationship of the profit plan, performance standards, and the profit improvement plan is shown in Fig. 14-1. A more extensive discussion of the profit plan and the profit improvement plan appears in Chapter 16.

Profit leakages, regardless of the level at which they occur or the degree of responsibility involved, signify that the planned profit objectives will not be attained unless these variances can be eliminated or offset elsewhere in the plan. The fact that an unfavorable budget variance is not considered controllable does not imply that management is powerless to take effective action.

An unanticipated rise in the price of raw materials may be beyond the control of management. However, the adverse effect of this price rise on the company's profit plan can be calculated, and management can focus its attention on alternative possibilities for "plugging" the leakage. These

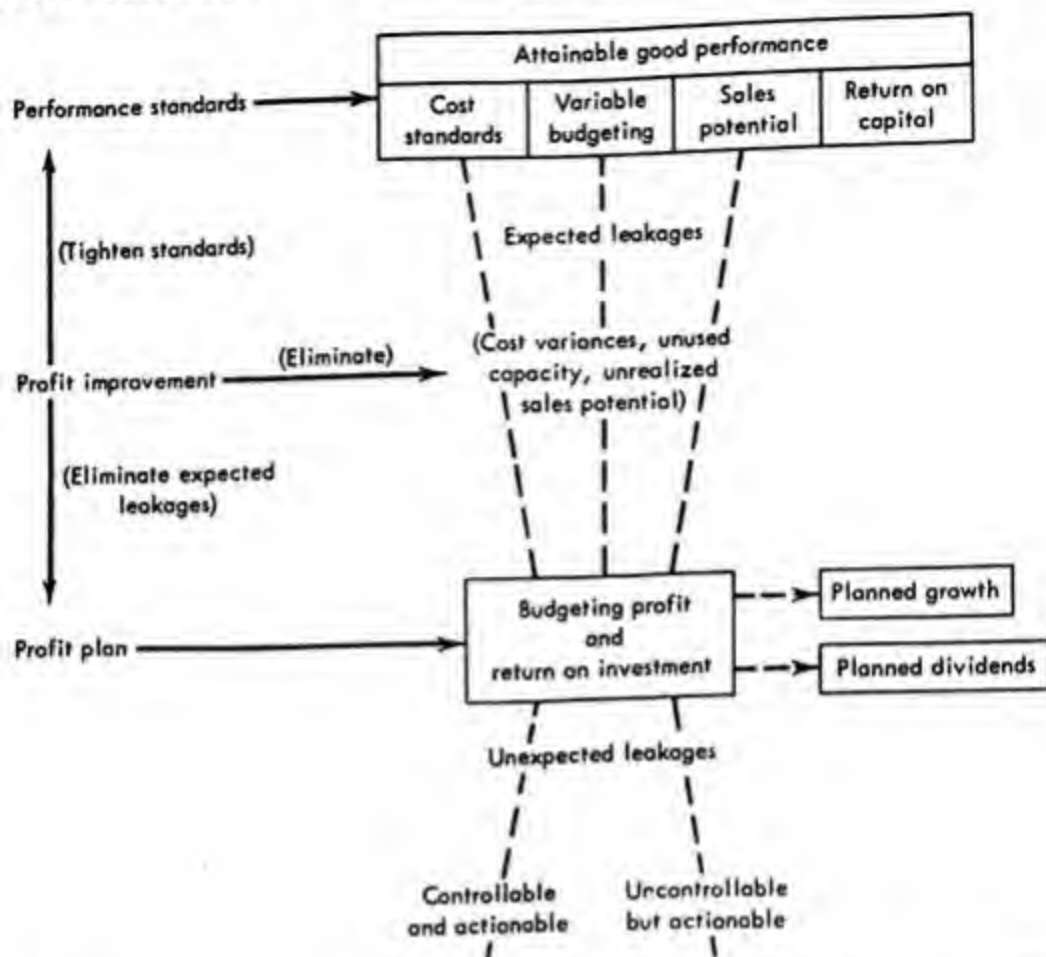


Fig. 14-1 Interrelationship of performance standards, profit plan, and profit improvement plan.

alternatives might, for example, result in a compensating increase in the price of the finished product, in the use of substitute materials, or even in a reduction in the size or quality of the product.

### Performance evaluation and the organization structure

Performance evaluation is closely linked to a company's organization structure. In some cases, the more decentralized a company, the easier it is to measure performance, since decentralization represents a delegation of authority and responsibility. Decentralization assumes different forms, as, for example, *functional* decentralization, *geographical* decentralization, and *profit* decentralization.

The extent to which a company is decentralized largely depends on the nature of its production and distribution activities and management's attitude toward delegation of responsibility. Decentralization is only relative. Even in a highly decentralized company, services are rendered to divisions by the central administration, advertising department, and research center. A single plant may produce items for more than one division or product line. Salesmen may handle the products of two or more divisions.

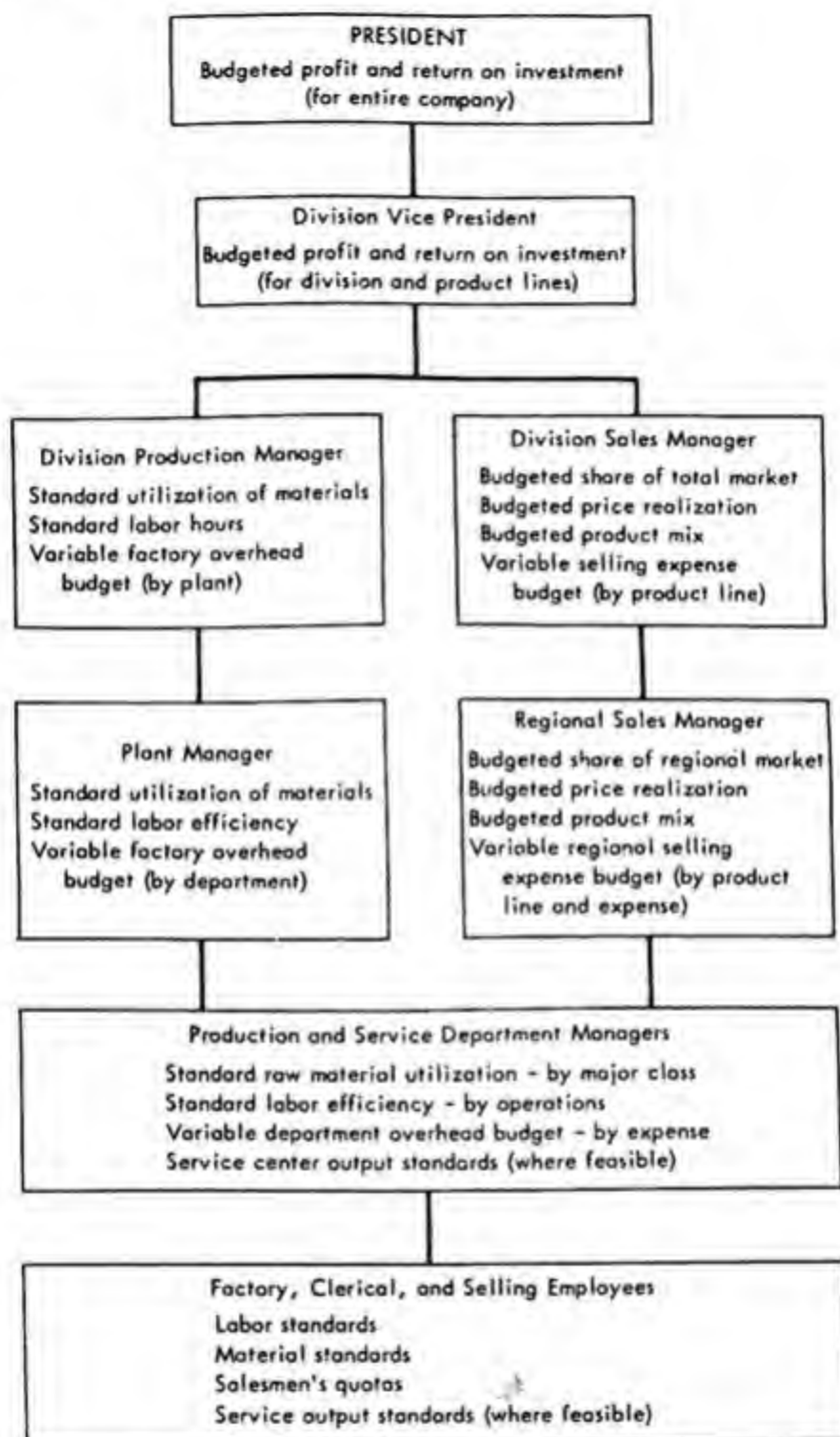


Fig. 14-2 Performance standards and levels of responsibility.

Profit decentralization is based on a separation of activities and lines of authority according to profit-oriented sectors. In most large companies, this assumes the form of product lines and divisions. A division may contain several plants and its own service centers, such as accounting, purchasing, and product designing. While a division may possess consider-



able autonomy, it is held responsible for meeting profit targets and performance standards. Many large American companies have adopted this kind of organization structure. For example, General Electric has divided its corporate structure into over a hundred profit centers.

A company's organization structure may be viewed as a pyramid of responsibilities. At the base are the responsibilities of factory, clerical, and selling employees, and at the apex those of the president. Each level of activity is responsible to the next higher level. This is illustrated in Fig. 14-2. The type of performance standard used varies at different levels of responsibility. The efficiency of factory workers is measured in terms of standard hours and standard reject allowances. The president's performance is measured against the company's profit plan and budgeted return on investment.

A company may not achieve its profit target for a variety of reasons. Those profit leakages that are classified as controllable are assigned to appropriate functional areas and levels of responsibility. Those that are regarded as uncontrollable are not assigned to individuals. The major categories of profit leakages and their assignment to functional areas are shown in Fig. 14-3. The sales function in Fig. 14-3 is responsible for attaining the budgeted share of the actual

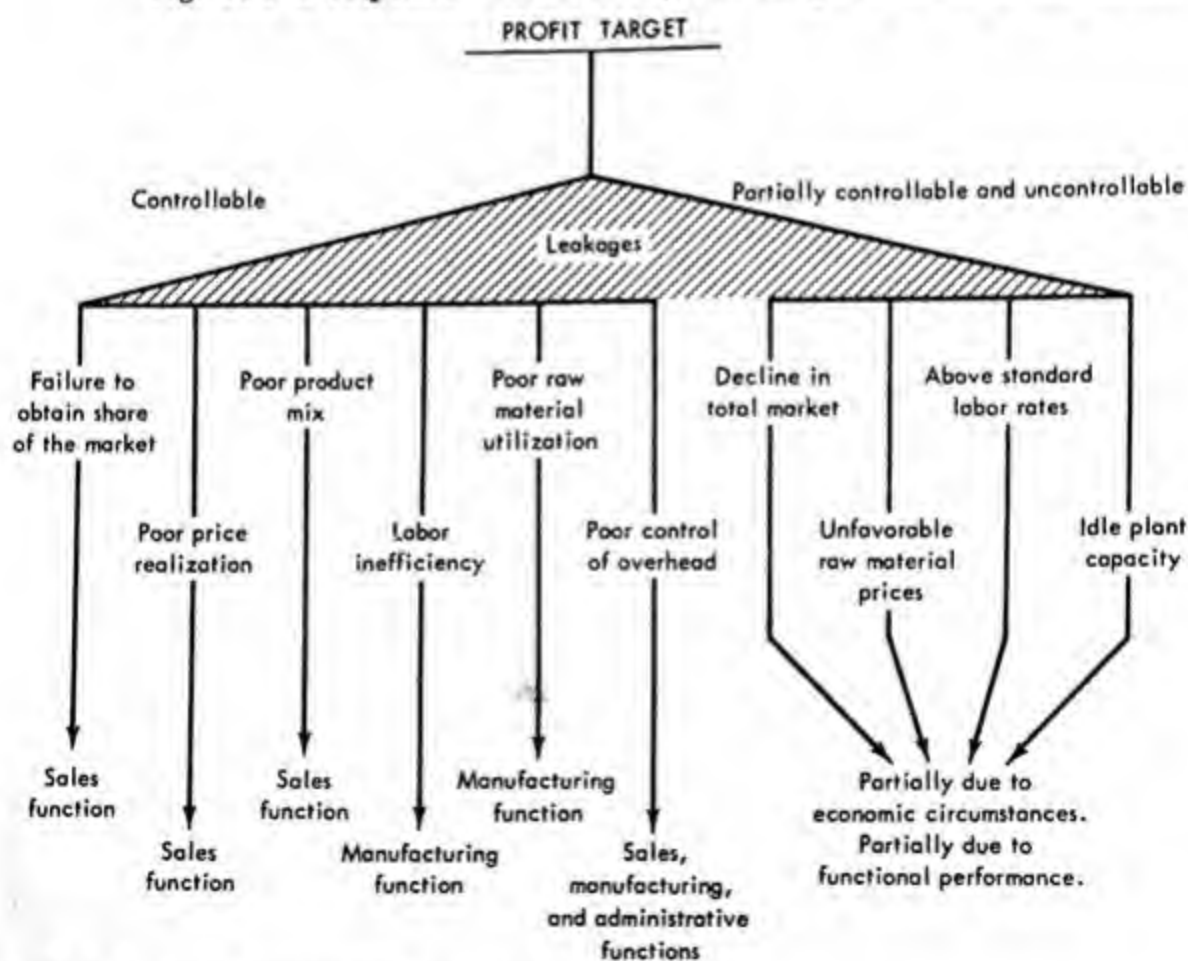


Fig. 14-3 Profit leakages and functional responsibility.



market, sales price realization, budgeted product mix, and selling expense control. However, the effect on profits resulting from a difference between the actual and expected market is due to economic conditions and is uncontrollable.

When factory-overhead rates are based on expected sales, a volume variance is controllable to the extent that it is due to the sales function not attaining the budgeted share of the actual market. The volume variance is uncontrollable if the factory is operating below the budgeted level because of economic conditions affecting the entire industry, i.e., because the actual market is below anticipations. At this point the reader need not be concerned with the calculation and reporting of profit plan variances. This will be discussed in detail in Chapter 16.

In Fig. 14-4, variances from performance standards are linked to levels of responsibility. At each level, executives essentially are concerned with the performance of the immediately subordinate level. Thus, the president is provided with a report showing not only the company's over-all performance but that of each of the company's divisions. The report fur-

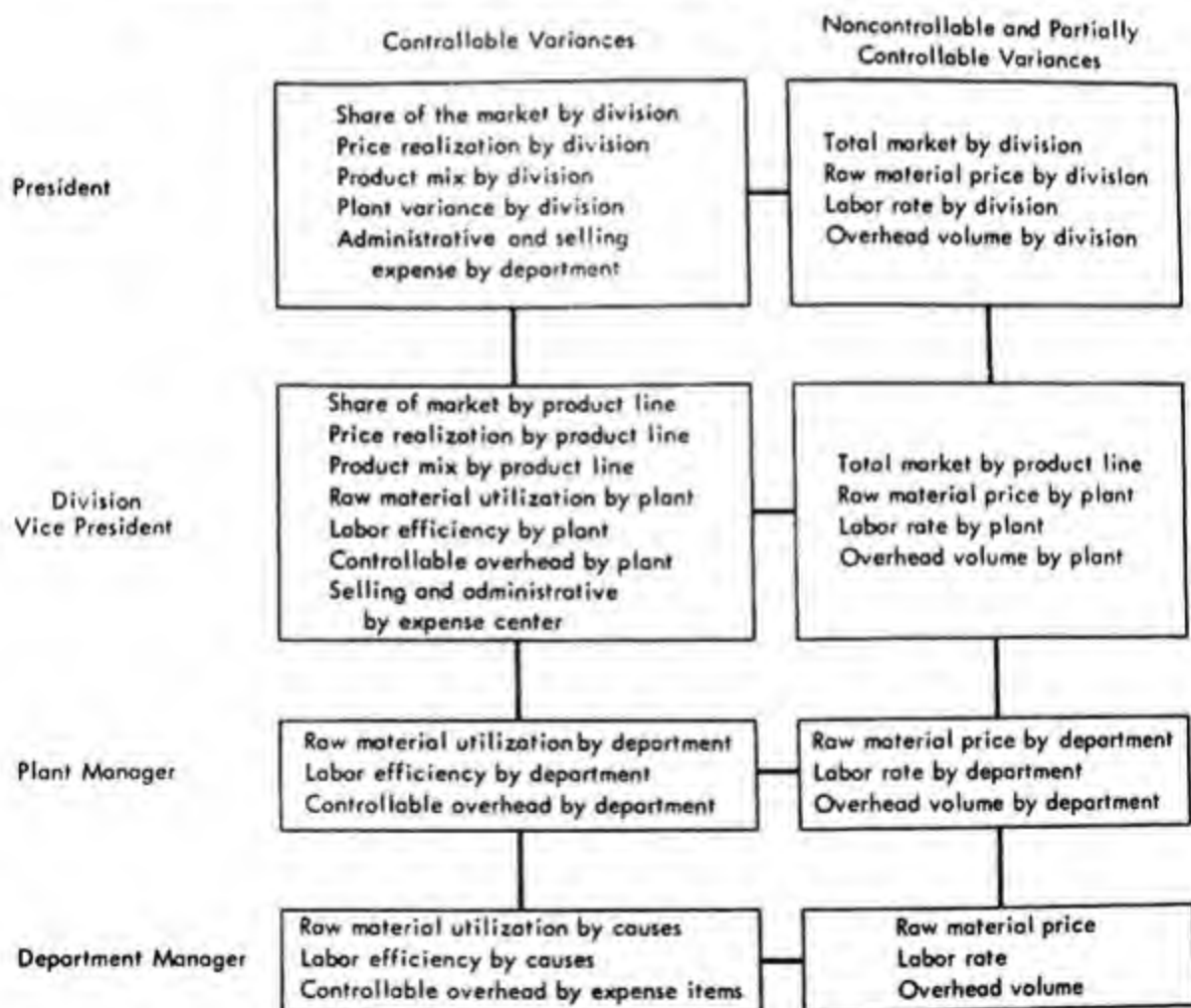


Fig. 14-4 Variances from performance standards viewed at different levels of responsibility.

nished to a division vice-president discloses the performance of plant managers and product-line managers within the division. Performance reports contain greater detail at lower levels of responsibility. At the plant manager's level, raw materials utilization variances are summarized by departments, whereas at the department manager's level the causes of the variances are reported. This facilitates corrective action at the appropriate level of responsibility.

### Accounting performance standards and human behavior

During recent years, social scientists have conducted extensive research in the area of human motivation. The results have been critical of accounting criteria as a basis for evaluating performance. These criticisms may be summarized as follows:

1. Accounting criteria are regarded by supervisory personnel as pressure instruments. They evoke negative reactions toward controls and create resistance blocks within an organization. This antagonism toward accounting performance standards appears to arise partly from job insecurity and partly from opposition to a nonparticipative type of management. Pressure to improve performance creates tensions and leads individuals to form groups which informally agree to resist these efforts. This ultimately creates a lack of incentive and a loss of interest in improving efficiency.

2. Accounting performance standards arouse interdepartmental conflicts. This occurs as supervisors, reacting to pressure, tend to shift responsibility to other departments. A lack of over-all unity develops as department-centered interest replaces company objectives. Cost accountants and budget supervisors particularly are resented by line executives, since the accountants and budget supervisors are constantly striving to find areas of weakness and bring them to management's attention.

3. Accounting performance standards lack flexibility. According to this criticism, business conditions are constantly changing, whereas accounting standards tend to be static. The critics who hold this view contend that in a dynamic environment reliance must be placed on the human resources of an organization rather than conformance to inflexible standards.

These are indeed serious criticisms. Yet few social scientists would deny the potentiality of accounting performance standards. On the contrary, their research efforts focus attention on the apparent failure of accountants and management to understand motivation and to communicate properly. In many companies, changes have already taken place, and accounting performance standards have become part of a participative type of management rather than a pressure tool. The desirability of this form of management is underscored by Rensis Likert<sup>3</sup> as follows:

<sup>3</sup> Rensis Likert, "Measuring Organizational Performance," *Harvard Business Review*, vol. 36, No. 2, March-April, 1958.

The traditional theory of management is based on scientific management, cost accounting and related developments, and general administrative concepts taken from military organizational theory. As a consequence, it calls for measurements that are concerned with such end-result variables as profits and costs, or with such process variables as productivity.

Substantial research findings show, however, that the managers in business and government who are getting the best results are systematically deviating from this traditional theory in the operating procedures they use. The general pattern of these deviations is to give more attention to motivation than the traditional theory calls for. High producing managers are not neglecting such tools and resources provided by scientific management as cost accounting; quite to the contrary, they use them fully. But they use these tools in special ways that achieve significantly higher motivation than is obtained by those managers who adhere strictly to the methods specified by the traditional theory of management.

### *Measuring the performance of salesmen*

Performance evaluation and the profit plan are closely related. To illustrate this in detail let us consider the measurement of salesmen's performances. The effectiveness and efficiency of salesmen can be measured in several different ways, including by (1) actual sales, (2) sales trend analysis, (3) sales potential, (4) selling-expense standards, (5) product mix sold, (6) profitability, and (7) profit gained or lost in comparison with budget. In the discussion which follows, each of these methods will be evaluated.

#### **Actual sales**

The effectiveness of salesmen often is judged on the basis of actual sales. From the data shown in Exhibit 14-5 for the Ardsley Company, Lambert

**Exhibit 14-5**

THE ARDSLEY COMPANY	
Actual Sales Performance	
New York and New Jersey Area	
Year Ended December 31, 1964	
<i>Salesman</i>	<i>Actual sales</i>
J. Adler.....	\$120,000
R. Coyle.....	80,000
A. Garner.....	110,000
T. Hughes.....	90,000
W. Lambert.....	130,000
Total.....	<u>\$530,000</u>

*Exhibit 14-6*

**THE ARDSLEY COMPANY**  
 Percentage Increase in Sales over Prior Year  
 New York and New Jersey Area  
 Four Years Ended December 31, 1964

Salesman	Year			
	1961	1962	1963	1964
J. Adler.....	+ .1%	- .4%	+1.1%	- .2%
R. Coyle.....	+3.1	+2.5	+ .2	- .8
A. Garner.....	+ .3	-1.6	+1.4	+ .9
T. Hughes.....	+2.1	+1.7	+1.6	+2.4
W. Lambert.....	-1.4	+1.6	-1.5	-1.1

would be regarded as the best salesman. This method does not give consideration to unequal territory potentials. An ineffective salesman may achieve a high volume and an efficient salesman may have comparatively poor results because of different territory potentials. A high-volume salesman also may incur disproportionately high selling costs, so that his direct profit actually earned is relatively low.

#### Sales trend analysis

The efficiency of salesmen also may be gauged by comparing their current performance with that of prior years. Salesmen showing the largest percentage increase are regarded as the most efficient. According to this method, from the data contained in Exhibit 14-6, Hughes would be judged the best salesman. While this type of comparison is not without value, it fails to give consideration to market potentials, the mix of products sold, and expense control.

#### Sales potential

Another method for evaluating salesmen is to determine the potential sales for the company's products in each salesman's territory and to compare the percentage of potential achieved with the company's expected share of the market. On this basis (Exhibit 14-7), Coyle emerges as the most effective salesman. Potentials are not always easy to establish at the salesman's level. Consideration must be given to the nature, composition, and location of customers. Apart from this difficulty, sales potentials ignore the mix of products sold and the degree of expense control exercised.

*Exhibit 14-7*

**THE ARDSLEY COMPANY**  
 Comparison between Actual Sales and Quota  
 New York and New Jersey Area  
 Year Ended December 31, 1964

<i>Salesman</i>	<i>Territory sales potential</i>	<i>Company quota (8.5% of sales potential)</i>	<i>Actual sales</i>	<i>Over or (under) quota</i>	<i>Over or (under) quota</i>
J. Adler .....	\$1,500,000	\$127,500	\$120,000	\$ (7,500)	- 5.9%
R. Coyle .....	750,000	63,750	80,000	16,250	+25.5
A. Garner .....	1,300,000	110,500	110,000	(500)	- .5
T. Hughes .....	1,000,000	85,000	90,000	5,000	+ 5.9
W. Lambert .....	1,800,000	153,000	130,000	(23,000)	-15.0
Total .....	\$6,350,000	\$539,750	\$530,000	\$ (9,750)	- 1.8

**Selling-expense standards**

Salesmen may be judged by their conformance to selling-expense standards. Traveling-expense standards may be established on the basis of the distance traveled and the number of customer calls. Entertainment, gifts, and promotion expenses can be based on the number, size, and sales potential of customers in each territory. On the basis of conformance to selling-expense standards (Exhibit 14-8), Adler is the most effective salesman.

*Exhibit 14-8*

**THE ARDSLEY COMPANY**  
 Comparison between Actual and Standard Selling Expenses  
 New York and New Jersey Area  
 Year Ended December 31, 1964

<i>Salesman</i>	<i>Actual selling expenses</i>	<i>Standard selling expenses</i>	<i>Variance</i>	<i>Variance percent of standard</i>
J. Adler .....	\$ 33,180	\$ 34,080	\$ 900	+2.6%
R. Coyle .....	25,960	24,460	(1,500)	-6.1
A. Garner .....	32,100	31,600	(500)	-1.6
T. Hughes .....	30,120	27,720	(2,400)	-8.7
W. Lambert .....	42,180	40,880	(1,300)	-3.1
Total .....	\$163,540	\$158,740	\$(4,800)	-3.0



For simplicity, in Exhibit 14-8, the standard for all expenses other than salaries and commissions has been set at 14 percent of sales. Selling commissions are 8 percent of sales. Basic salaries are as follows: Adler, \$7,680; Coyle, \$6,860; Garner, \$7,400; Hughes, \$7,920; and Lambert, \$12,280. While this simplified form of setting selling-expense standards serves our purpose, in practice each item of expense should be carefully studied and standards individually established.

Apart from the difficulty in setting standards, relatively few companies use them because of a fear of unfavorable reactions from salesmen. Selling-expense standards also fail to give consideration to the volume achieved and product mix sold.

### Product mix sold

Profit margins generally vary for different products. Often, there is less sales resistance on lower-profit items. In order to obtain a desired balance of products sold, higher sales commissions may be established for high-profit items. If quotas exist, they are based on a desired product mix. As indicated in Exhibit 14-9, Garner achieved the most profitable sales mix. The standard variable factory costs of products sold by Garner amounted to only 41.45 percent of sales as compared with the company's budget of 44 percent.

### Profitability

Although rarely prepared, a report showing the profit contribution of salesmen provides management with a tool for appraising selling efficiency. The report should show each salesman's sales less variable factory costs and selling expenses applicable to the salesmen. Certain selling

#### Exhibit 14-9

**THE ARDSLEY COMPANY**  
Variable Factory Costs of Product Mix Sold  
New York and New Jersey Area  
Year Ended December 31, 1964

	<i>Budgeted variable factory cost, (44% of sales)</i>	<i>Standard variable factory cost of actual sales</i>	<i>Profit gained or lost on budget mix</i>
J. Adler.....	\$ 52,800	\$ 52,800	-0-
R. Coyle.....	35,200	37,800	\$(2,600)
A. Garner.....	48,400	45,600	2,800
T. Hughes.....	39,600	40,400	(800)
W. Lambert.....	57,200	57,400	(200)
Total.....	\$233,200	\$234,000	\$ (800)

Exhibit 14-10

THE ARDSLEY COMPANY  
Profitability of Salesmen  
New York and New Jersey Area  
Year Ended December 31, 1964

	Salesmen					
	J. Adler	R. Coyle	A. Garner	T. Hughes	W. Lambert	Total
Sales.....	\$120,000	\$80,000	\$110,000	\$90,000	\$130,000	\$530,000
Less: Direct costs:						
Factory (at standard):						
Materials.....	\$ 24,000	\$17,000	\$ 20,000	\$18,000	\$ 27,000	\$106,000
Direct labor.....	18,000	13,000	16,000	14,000	19,000	80,000
Variable overhead (60 % direct labor).....	10,800	7,800	9,600	8,400	11,400	48,000
Total direct factory.....	\$ 52,800	\$37,800	\$ 45,600	\$40,400	\$ 57,400	\$234,000
Percent direct factory.....	44.0	47.2	41.5	44.9	44.2	44.1
Selling:						
Salaries and commissions.....	\$ 17,280	\$13,260	\$ 16,200	\$15,120	\$ 22,680	\$ 84,540
Traveling.....	4,000	4,600	4,800	4,800	5,600	23,800
Entertainment and gifts.....	2,400	1,800	2,200	2,100	2,800	11,300
Cooperative advertising and promotion.....	4,000	2,500	3,900	3,700	5,000	19,100
Freight.....	5,000	3,000	4,400	3,500	5,400	21,300
Bad debts.....	500	800	600	900	700	3,500
Total direct selling.....	\$ 33,180	\$25,960	\$ 32,100	\$30,120	\$ 42,180	\$163,540
Percent direct selling.....	27.7	32.5	29.2	33.4	32.4	30.8
Total direct costs.....	\$ 85,980	\$63,760	\$ 77,700	\$70,520	\$ 99,580	\$397,540
Direct salesmen's profit.....	\$ 34,020	\$16,240	\$ 32,300	\$19,480	\$ 30,420	\$132,460
Percent direct profit.....	28.3	20.3	29.3	21.7	23.4	25.1

expenses such as compensation, traveling, discounts, allowances, gifts, promotions, cooperative advertising, samples, and bad debts can be identified directly with each salesman. On the other hand, freight has to be allocated on the basis of quantities shipped and distances. Exhibit 14-10 shows how the Ardsley Company might report the profitability of its salesmen. The largest dollar profit contribution is made by Adler. The major limitation of this type of report is that it fails to give consideration to differences in territory potentials and the degree of conformance to selling expense standards.

### Profit gained or lost in comparison with budget

Different results are obtained under each of the foregoing methods. Confusion resulting from this situation can be overcome by combining the salient features of each method into a single system for measuring selling effectiveness. This criterion discloses the effect on profits of exceeding or not meeting budgeted targets for sales, product mix, and selling expenses. From the standpoint of conformance to these management targets, as shown in Exhibit 14-11, Garner must be considered the most efficient salesman.

The explanations which follow indicate how the data shown for Garner in Exhibit 14-11 were compiled.

1. Sales gained or lost. The sales gained or lost by each salesman ( $-\$500$  in the case of Garner) is obtained by comparing actual and budgeted sales.

2. Profit gained or lost on sales realization. This represents the sales gained or lost minus standard variable factory costs and standard incremental selling expenses applicable to these sales. Because Garner's sales were  $\$500$  less than his quota, the company sustained a net budget loss of  $\$170$ . The Ardsley Company's standard variable factory costs amount to 44 percent of sales. This is based on the budgeted product mix that the company desires to sell. (Separate consideration will be given to the effect on profits of a variation between the actual and budgeted product mix in the next paragraph.) Standard incremental selling expenses have been established at 8 percent for selling commissions and 14 percent for other selling expenses, or a total of 22 percent of sales. Fixed factory and selling expenses (salesmen's base salaries) are ignored, since they do not affect incremental profits.

3. Profit gained or lost because of product mix sold. In this calculation, consideration is given to the effect on profits of the actual mix sold not conforming to the budgeted mix. In the case of Garner, the standard variable factory costs of the units sold was only 41.45 percent of sales (Exhibit 14-10), as compared with the company standard of 44 percent. The profit gained as a consequence of Garner's more profitable product mix is  $(.44 - .4145) \times \$110,000$  or  $\$2,800$ .

4. Profit gained or lost through selling expense control. This represents the effect on profits of actual selling expenses exceeding or being less

Exhibit 14-11

THE ARDSLEY COMPANY

Profit Gained or Lost on Selling Effort

New York and New Jersey Area

Year Ended December 31, 1964

	Salesmen					Total
	J. Adler	R. Coyle	A. Garner	T. Hughes	W. Lambert	
Profit gained (or lost) on sales:						
Sales quota [Exhibit 14-7]	\$127,500	\$ 63,750	\$110,500	\$85,000	\$153,000	\$539,750
Actual sales [Exhibit 14-7]	120,000	80,000	110,000	90,000	130,000	530,000
Sales gained (or lost)	\$ (7,500)	\$ 16,250	\$ (500)	\$ 5,000	\$ (23,000)	\$ (9,750)
Less: Standard variable costs of sales gained (or lost):						
Standard variable factory costs at standard mix	\$ 3,300	\$ (7,150)	\$ 220	\$ (2,200)	\$ 10,120	\$ 4,290
Standard variable selling expenses	1,650	(3,575)	110	(1,100)	5,060	2,145
Total	\$ 4,950	\$ (10,725)	\$ 330	\$ (3,300)	\$ 15,180	\$ 6,435
Profit gained (or lost) on sales realization	\$ (2,550)	\$ 5,525	\$ (170)	\$ 1,700	\$ (7,820)	\$ (3,315)
Profit gained (or lost) on product mix sold and expense control:						
Standard direct factory costs at standard product mix [Exhibit 14-9]	\$ 52,800	\$ 35,200	\$ 48,400	\$39,600	\$ 57,200	\$233,200
Standard direct factory costs at actual product mix [Exhibit 14-9]	52,800	37,800	45,600	40,400	57,400	234,000
Profit gained (or lost) because of product mix sold	-0-	\$ (2,600)	\$ 2,800	\$ (800)	\$ (200)	\$ (800)
Standard selling expenses [Exhibit 14-8]	\$ 34,080	\$ 24,460	\$ 31,600	\$27,720	\$ 40,880	\$158,740
Actual selling expenses [Exhibit 14-8]	33,180	25,960	32,100	30,120	42,180	163,540
Profit gained (or lost) on control of selling expenses	\$ 900	\$ (1,500)	\$ (500)	\$ (2,400)	\$ (1,300)	\$ (4,800)
Total profit gained (or lost) on selling effort	\$ (1,650)	\$ 1,425	\$ 2,130	\$ (1,500)	\$ (9,320)	\$ (8,915)



than the standard expenses. In the case of Garner, actual selling expenses were \$32,100. The standard established by Ardsley's management for Garner is equal to his base salary (\$7,400) plus 8 percent commission (\$8,800) plus 14 percent for other selling expenses (\$15,400), or \$31,600 in aggregate. He, therefore, lost profit of \$500 because his selling expenses were not controlled sufficiently.

5. *Total profit gained or lost on selling effort.* In Garner's case, this represents the total of the profit lost because of failure to achieve his sales quota ( $-\$170$ ), the profit gained because of a favorable product mix sold ( $\$2,800$ ), and the profit lost by exceeding standard selling expenses ( $-\$500$ ), or  $\$2,130$ .

### *Internal (intracompany) transfer pricing*

In a multidivision and multiplant concern, products commonly are transferred from one internal sector to another. The prices at which these products are transferred affects the reported income of both the shipping and receiving units. Internal transfer prices thus are an important factor in performance evaluation. They also may have an influence on certain management decisions, such as whether to make or buy, whether to sell or process further, and selecting between alternative production possibilities.

Several pricing methods may be used to account for internal transfers. The selection of an appropriate pricing procedure depends partly upon management's objectives and partly upon the relative merits of the different pricing schemes. Unfortunately, each pricing system has limitations as well as advantages. Also, management may have multiple objectives, and a particular pricing method may not serve these different goals equally well. For these reasons, it is extremely difficult for a company to establish a logical and sound policy on intracompany transfer prices.

#### **Intracompany transfer prices, performance evaluation, and decision making**

Internal transfer prices affect the profits of the shipping and receiving units. This may be illustrated by assuming that Division A of a company manufactures a single product with variable costs of \$10, which is sold externally at \$15. One-half of the units sold by Division A represent transfers to Division B. In addition to the cost of products transferred from Division A, Division B has other variable costs of \$10 per unit. Division B sells all its products to outsiders at a price of \$30 a unit. Exhibit 14-12 shows the effect of transferring the products internally (1) at variable cost, and (2) at market price.

Let us now assume that the selling price of the end product sold by Division B declines from \$30 to \$24. If market price is used as the basis



*Exhibit 14-12*Illustration of the Effect on Division Profits  
of Intracompany Transfer Prices

Transferred at variable cost				
	Division A		Division B	
Sales:				
To outsiders .....	50,000 @ \$15	\$ 750,000	50,000 @ \$30	\$1,500,000
Internally .....	50,000 @ \$10	500,000	-0-	-0-
Total sales .....		<u>\$1,250,000</u>		<u>\$1,500,000</u>
Less: Variable costs				
Materials .....				\$ 500,000
Other variable costs ..				500,000
Total variable costs		<u>1,000,000</u>		<u>\$1,000,000</u>
Contribution margin .....		<u>\$ 250,000</u>		<u>\$ 500,000</u>

Transferred at market price				
Sales:				
To outsiders .....	50,000 @ \$15	\$ 750,000	50,000 @ \$30	\$1,500,000
Internally .....	50,000 @ \$15	750,000	-0-	-0-
Total sales .....		<u>\$1,500,000</u>		<u>\$1,500,000</u>
Less: Variable costs				
Materials .....				\$ 750,000
Other variable costs ..				500,000
Total variable costs		<u>1,000,000</u>		<u>\$1,250,000</u>
Contribution margin .....		<u>\$ 500,000</u>		<u>\$ 250,000</u>

for billing intracompany transfers, it would seem undesirable for Division B to continue to operate, since Division B's variable costs per unit would exceed the selling price, as shown below:

	<i>Per unit</i>
Selling price .....	<u>\$24</u>
Variable costs:	
Materials from Division A .....	\$15
Other variable costs .....	<u>10</u>
Total variable costs .....	<u>\$25</u>
Contribution margin .....	<u>\$(1)</u>

If Division A's variable costs are used as the basis for these intracompany transfers, an opposite conclusion is reached, as shown on the following page:

	<i>Per unit</i>
Selling price .....	\$24
Variable costs:	
Materials from Division A .....	\$10
Other variable costs .....	10
Total variable costs .....	\$20
Contribution margin .....	\$ 4

Let us now suppose that Division B can procure externally at \$12 a product identical to that which it presently receives from Division A. If Division A's transfer price is based on market (\$15), it would be advantageous to Division B to purchase these items on the outside. However, this would be disadvantageous to the company, since Division A's variable costs are only \$10 per unit.

### Intracompany pricing methods

This discussion of intracompany transfer pricing methods will be confined to the following: (1) absorption cost, (2) variable cost, (3) cost plus a markup, (4) market price, and (5) negotiated price. While other methods may be used, they essentially would be variations of the foregoing.

**Absorption cost.** Absorption cost, either actual or standard, frequently is used for billing intracompany transfers. If standards are used, variances from standard that represent inefficiencies should be borne by the shipping division. The use of absorption factory cost for internal transfers avoids the necessity of eliminating intracompany profits from inventories for external reporting.

From the standpoint of performance evaluation, the absorption cost price is unsatisfactory. This method does not reflect the revenue potential of the products transferred. Under this procedure, the income of the shipping unit normally will be understated and that of the receiving unit overstated. The absorption cost method also may lead management of the receiving division to make decisions contrary to the best interests of the company. In most short-run decisions, variable costs are the relevant costs.

**Variable cost.** When variable costs are used as the basis for billing intracompany transfers, more useful information is obtained for short-run decision making. For example, the manager of a division receiving goods from another division would add his variable costs to those billed by the shipping unit. The combined variable costs would then represent the minimum selling price for the end product. Any price obtained in excess of the total variable costs would result in an incremental profit to the company.

From the standpoint of performance evaluation, this method clearly is unfair to the shipping division. It not only does not provide a profit but even fails to recover the fixed costs of the transferrer. This method

also would entail an adjustment to inventories of work in process and finished goods for fixed factory overhead excluded from the transfer price, i.e., unless direct costing were in use.

**Cost plus a markup.** When a market price does not exist for an internally transferred product, it may be simulated by adding a markup to either the variable or full cost. If the markup is added to the variable cost, the price transfer is designed to include a recovery of fixed costs plus an agreed profit margin. If the markup is added to the absorption cost, the transfer price covers only a profit margin.

A variant of this method may be used by companies that evaluate internal performance in terms of return on investment. Under this variation, the supplier is permitted to establish internal prices at a level which will yield a stipulated return on invested capital. Let us suppose that a plant produces 20,000 units of a product for another plant within the company and that a capital investment of \$400,000 is required to manufacture these items. Management has decided that a 15 percent return on investment should be allowed the supplier. If the cost per unit of the product is \$30, then the transfer price would be set at \$33, calculated as follows:

Investment per unit: \$400,000/20,000 .....	\$20
Return on investment per unit: .15 × \$20 .....	3
Transfer price: \$30 + \$3 .....	33

There are several disadvantages to this method and variations of it. First, there must be agreement as to what represents an acceptable cost. The costs of the supplier may be challenged by the receiving unit, particularly when the transferrer is regarded as inefficient, is operating at a low level of capacity, or has employed questionable procedures in allocating joint costs. An accord must be reached as to which selling, administrative, and research costs, if any, are to be included in the transfer price. Costs also should be adjusted to give effect to savings resulting from large quantities purchased.

Second, it is quite difficult to specify what constitutes a fair profit margin or return on capital. If a major portion of the supplier's output is sold externally, one might argue that the profit margin earned on outside sales should be applied to internal transfers. In order to calculate the profit margin on external sales, it is necessary to segregate costs between outside sales and internal transfers. This rarely can be accomplished without controversy as to the allocation procedures used. If only a small portion of the supplier's output is sold to outsiders, management may have to decide, more or less arbitrarily, what profit margin is fair under the circumstances.

Third, this method guarantees the supplier, at least in regard to internal transfers, a stipulated profit or rate of return on capital. Yet, these are indices of performance that management is trying to use in measuring performance.

**Market price.** When there is an existing market price for internally transferred products, market price generally represents the most desirable basis for billing intracompany transfers, at least from the standpoint of performance evaluation. The market price is an opportunity cost. To the transferrer, market price represents potential revenue lost. To the transferee, market price represents the cost that would have to be paid if the products were purchased externally.

Unfortunately, a market price frequently does not exist, particularly when the products transferred internally are manufactured exclusively for company end products. Even when a market price exists, it rarely can be applied to internal transfers without adjustment.

The quantities transferred often are substantial, resulting in cost economies to the supplier. Some form of volume discount therefore would seem warranted. The market price presumably includes provision for recovery of advertising, sales promotion, selling commissions, credit and collection, and other costs which are not incurred in connection with intracompany transfers. If internal transfers are made directly from the supplier's plant, the cost of warehousing should be excluded from the transfer price. Financial discounts offered to external customers also should be granted on internal transfers. Assuming that a market price exists, these adjustments might be expressed in percentage form and calculated as follows:

	<i>Percent</i>
Market price.....	100.0
Less:	
Financial discount.....	2.0
Selling costs.....	20.0
Credit costs.....	.5
Warehousing costs.....	4.0
Total deductions.....	26.5
Intracompany transfer price as a percentage of market price.....	73.5

Market price as the basis for billing intracompany transfers is used extensively in the oil industry. This may be illustrated by referring to Esso Standard.<sup>4</sup> Crude oil is charged to company refineries at the prevailing market price, regardless of whether the crude oil is purchased from affiliated companies whose actual cost of production is known. The cost of transporting the crude oil to company refineries is based on published ICC pipeline and tanker charter rates, even where such transportation facilities are provided by affiliated companies.

**Negotiated price.** Profit decentralization implies that division managers be permitted the widest latitude over the activities of their division. Accordingly, some companies allow their division managers to negotiate intracompany transfer prices as though they were managing independent

<sup>4</sup> See A. D. Kaplan, Joel B. Dirlam, and Robert F. Lanzillotti, *Pricing in Big Business* (Washington, D.C.: The Brookings Institution, 1958), p. 80.



concerns. The purchasing division is permitted to obtain external price quotations which are used as the basis for negotiating intracompany transfer prices. If the internal supplier cannot meet the external competition, the purchasing division is permitted to obtain the items outside the company. It is presumed that the internal supplier will meet the outside price if excess plant capacity exists, provided the price exceeds the variable costs per unit.

This system can prove effective if a market price exists or if reliable price quotations can be obtained. However, outside quotations may not be dependable. The outside supplier may deliberately quote a low price in order to procure the business, planning to increase the price at a subsequent date. This method is based on the assumption that independent negotiations between internal managers will produce results beneficial to the company as a whole. Situations can arise in which the interests of a division conflict with those of the company, particularly if outside purchases are permitted of items made internally.

### Summary

Internal profitability and return on capital are important measurements of divisional performance. In order to calculate internal profits, it is necessary to attach a price to intracompany transfers which is fair to both the shipping and receiving divisions. However, difficult conceptual problems are involved in the selection of an internal pricing system. To a large extent, the adoption of a particular pricing scheme depends upon management's objectives and the nature of a company's internal activities. Apart from these factors, certain general observations are pertinent:

1. Intracompany pricing affects decision making as well as performance evaluation. This is a complicating factor, since the types of data needed for these two management functions generally are different. It is desirable therefore to separate the data. This can be accomplished by providing each sector receiving internally transferred goods with a schedule of the cumulative variable cost of each product. If standard costs are used, it may be necessary to revise the schedule from time to time as significant labor rate and materials price variances occur. The schedule of variable costs can be used for initiating studies in such areas as make or buy, sell or process, without having to rely upon intracompany transfer prices.

2. Many companies attempt to prepare profit statements at the plant level, as well as for divisions. This necessitates the establishment of internal prices for interplant transfers, even when such transfers are entirely within the confines of a single division. This is a questionable procedure. *Plant* management ordinarily has no jurisdiction over sales. Plant managers should be judged only on the basis of *factory* activities. Standard costs and variable expense budgets are the accounting criteria that are most appropriate for measuring factory performance.

3. The problem of transfers between divisions sometimes can be mini-



mized by restructuring the organization lines. For example, if plant 1 of Division A transfers a major portion of output to Division B, plant 1 probably should be included in the organization structure of Division B rather than A.

4. If a plant's output is distributed approximately equally among several divisions, absorption (standard) cost would seem to represent the most logical basis for pricing internal transfers. Plant variances should also be allocated among the divisions. In effect, this means that each division would be charged for a proportionate share of the total plant costs.

5. If only a minor portion of a plant's output is transferred to another division, the transfer price logically should be based on an opportunity cost concept, and some form of adjusted market price should be used.

### *Problems and cases*

- 14-1 *Objectives of performance evaluation.* What are the general objectives of performance evaluation?
- 14-2 *Objectives, plans, and standards.* Distinguish among objectives, plans, and standards of performance.
- 14-3 *Performance standards and plans.* "A performance standard may be attainable, but there may be no expectation of realizing it during a given time period." Explain. How does this affect plans?
- 14-4 *Internal profit concepts.* List and describe briefly the different profit concepts that might be used to measure the performance of a division.
- 14-5 *Intracompany transfer pricing methods.* List and describe the different techniques that might be used to price intracompany transfers.
- 14-6 *Responsibility for unfavorable variances.* Indicate what quantitative criteria could be effectively used to measure performance in the following cases:
1. Drill-press operators
  2. Delivery-route men
  3. Factory department supervision
  4. Billing department
  5. Electrical maintenance department
  6. Salesmen
  7. Tax department
  8. Division manager
  9. Inspectors
  10. Purchasing department
- 14-7 *Responsibility for unfavorable variances.* You are the cost accountant for a large metal-fabricating concern. The company uses a standard cost system and variable budgeting. You are convinced that the variance reports your department issues are not as effective as they should be. A principal reason

for this is because of the tendency of department heads to shift responsibility for unfavorable variances to other departments.

1. Give examples of how a department head could argue that excess costs appearing on his report were the fault of another department.
2. How would you as chief cost accountant cope with this situation?

**14-8** *Criteria for evaluating division performance.* In regard to the evaluation of a division's performance, indicate the advantages and limitations of the following criteria:

1. Period profit
2. Return on sales
3. Return on capital employed
4. Standard costs
5. Budgets
6. Sales growth trend
7. Labor turnover

**14-9** *Difficulties encountered in interplant and interdivision comparisons.* Indicate how each of the following presents difficulties in comparisons of interplant and interdivision performance:

1. What items to include in the capital base
2. What value to attach to capital employed
3. Jointly used capital assets
4. Price fluctuations
5. Allocation of costs
6. Predetermined overhead rates

**14-10** *Competitive intracompany prices.* A large automobile-manufacturing concern permits each of its divisions and plants to buy parts from outsiders, even though made by other plants in the company, provided that the outside price is lower than the intracompany price. The company's management believes that, unless intracompany prices are competitive, a plant or division's performance cannot be accurately measured. What is your opinion of this system?

**14-11** *Measuring the quality of the human organization.* Comment on the following statement:

"... Virtually all companies regularly secure measurements which deal with such end results as production, sales, profits, and percentage of net earnings to sales. The accounting procedures of most companies also reflect fairly well the level of inventories, the investment in plant and equipment, and the condition of plant and equipment.

"But much less attention is given to what might be called 'intervening factors,' which significantly influence the end results just mentioned. These factors include such qualities of the human organization that staffs the plant as its loyalty, skills, motivations, and capacity for effective interaction, communication, and decision-making. At present there is not one company, to my knowledge, that regularly obtains measurements which adequately and accurately reflect the quality and capacity of its human organization. (But in two companies experimental programs are underway to develop measurements of this kind.)

"There are two principal reasons for this situation: (1) The traditional theory of management, which dominates current concepts as to what should

be measured, largely ignores motivational and other human behavior variables.  
(2) Until recently the social sciences were not developed enough to provide methods for measuring the quality of the human organization."

14-12 *Adequacy of quantitative data in planning for the future.* Comment on the following statement:

"Like many other companies, General Electric has long felt a need for more exact measurements and standards of performance, not only to evaluate past results, but to provide a more accurate means for planning future activities and calculating business risks. The traditional measures of profits such as return on investment, turnover, and percentage of net earnings to sales provide useful information. But they are hopelessly inadequate as measures to guide the manager's effectiveness in planning for the future of the business—the area where his decisions have the most important effects."

14-13 *Evaluating performance of a manufacturing operation.* The Starlight Electric Corporation manufactures a line of electrical parts in its New England plant.

<sup>1</sup> Rensis Likert, "Measuring Organizational Performance," *Harvard Business Review*, vol. 36, 1958.

<sup>2</sup> Ralph J. Cordiner, *New Frontiers for Professional Managers* (New York: McGraw-Hill Book Company, 1956).

### Exhibit I

#### THE STARLIGHT ELECTRIC CORPORATION Molding Department Performance Report

	Period I	Period II	Period III	Period IV
Material X.....	\$132,000	\$122,000	\$134,000	\$153,000
Material Y.....	66,000	56,400	63,000	77,000
Direct labor.....	86,000	82,000	89,000	103,000
Indirect labor.....	42,000	38,600	41,000	49,000
Supplies.....	28,000	16,000	27,200	29,000
Repairs.....	26,000	24,000	30,000	31,000
Depreciation—direct.....	8,000	8,000	8,000	8,000
Allocated costs.....	38,000	38,000	38,000	38,000
Total costs.....	<u>\$426,000</u>	<u>\$385,000</u>	<u>\$430,200</u>	<u>\$488,000</u>
Parts produced.....	4,000,000	3,500,000	3,800,000	4,200,000
Cost per part.....	<u>\$ .1065</u>	<u>\$ .110</u>	<u>\$ .1132</u>	<u>\$ .1162</u>
Adjusted market price.....	<u>\$ .115</u>	<u>\$ .115</u>	<u>\$ .115</u>	<u>\$ .115</u>
Department profit or loss.....	<u>\$34,000</u>	<u>\$17,500</u>	<u>\$6,800</u>	<u>\$(5,000)</u>

#### Additional data:

1. Direct hours worked..... 43,000 37,300 38,700 42,800
2. Materials used, lb
  - X..... 2,200,000 2,000,000 2,100,000 2,220,000
  - Y..... 330,000 235,000 242,000 285,000
3. Average hourly rate of indirect labor is 10% higher in periods III and IV than periods I and II
4. Supply prices have remained relatively constant

Each department manager is granted considerable authority in the operation of his department, including the hiring and discharging of employees. However, labor rates are established by the personnel department, and purchases are made by a centralized purchasing department.

The molding department manufactures plastic plugs exclusively. Approximately 80 percent of these plugs are transferred to other departments for assembly into finished products, and about 20 percent are sold to outsiders. The external price, adjusted for expenses not incurred on parts transferred internally, is used as the basis for measuring the performance of the molding department, as shown in Exhibit I. After studying this report, the president commented, "The efficiency of the molding department has been declining steadily. Actually, we would have been better off to shut down the department in period IV."

*Required:*

1. Do you agree with the president that the efficiency of the molding department has declined? If not, using the data given, prepare an exhibit that more accurately reveals the performance of the molding department.
2. Do you agree that the molding department should have been closed down in period IV? If not, prepare an exhibit to support your position.

**14-14** *Composite index for evaluating performance.* International Pump, Inc., consists of 12 operating divisions. Division managers are granted considerable discretion in setting employment, sales, and production policies. Capital investment funds are allocated to divisions by ranking capital projects according to their expected returns, regardless of originating division. In November, 1963, the president wrote the following letter to Mr. L. S. Rand, the firm's consultant.

Dear Mr. Rand:

For some time, I have been trying to develop a system which will provide an incentive to our division managers and a basis for evaluating their effectiveness. I am now convinced that only a composite index, as shown below, will give equal weights to the four principal objectives of a division. I propose to offer each division manager a \$500 bonus for each 1 percent increase in the composite index.

I would like to present this proposal to the board at the December meeting and, if approved, start the system next year. Please let me have your evaluation of this plan in writing.

Very truly yours,  
Arthur Davis, President

Composite Index for Evaluating Division Performance

Objective	Criterion	Last year	This year	Percent change
Minimize capital.....	Capital turnover	1.5	1.8	+20
Profitability.....	Return on sales	10.0%	9.0%	-10
Growth.....	Share of market	15.0%	15.3%	+ 2
Employee relations.....	Labor turnover	12.0%	12.24%	- 2
Net composite change...				+10



*Required:* Assuming that you were the consultant, write a letter to Mr. Davis, evaluating the proposal.

- 14-15** *Evaluating performance of salesmen.* The Oxford Shirt Company establishes sales quotas and selling expense standards for each salesman on the basis of relevant territory statistics. Each salesman is expected to sell a standard mix of products which will yield a factory contribution ratio of 40 percent, i.e., the excess of sales over variable factory costs. The actual and budgeted data for the five salesmen in the North Central region, for the year 1963, are as follows:

Salesman	Sales		Factory contribution ratio, %		Variable selling expenses	
	Actual	Budget	Actual	Budget	Actual	Budget
Cronin.....	\$120,000	\$126,000	38	40	\$22,000	\$17,640
Di Maggio....	130,000	139,000	41	40	21,600	22,240
Gehrig.....	96,000	98,000	42	40	14,300	14,210
Ruth.....	136,000	132,000	37	40	20,100	19,800
Williams.....	110,000	105,000	39	40	15,900	16,800

*Required:*

1. From the actual data only, which salesman do you think was most effective?
2. What limitations are there to the use of actual data in judging sales performance?
3. Based on conformance with the established targets, which salesman do you regard as having been most effective?
4. What practical difficulties may be encountered in establishing salesmen's targets?

- 14-16** *Evaluating the performance of a division manager.* Creighton Mills, Inc., has three divisions: yarn, cloth, and sewing. The sewing division receives all its cloth from the cloth division and the cloth division all its yarn from the yarn division. The income statement for Creighton Mills for the year ended December 31, 1963, appears in Exhibit I. Upon receipt of the statement, the president commented: "I don't know what to do with the yarn division. This is the fourth successive year that it has reported a loss. If Bill Carson can't make money for us, I'd better start thinking about a new manager." The yarn division has a new spinning plant, constructed 4 years ago. Carson was appointed division manager in 1961. During the past 2 years, internal transfers of yarn have remained about the same, while sales to outsiders have risen approximately 25 percent.

Shortly after the close of the year 1963, Mike Sanders, manager of the cloth division, receives a telephone call from an independent cloth distributor, who indicates that he could obtain an order from the Styletex Garment Company for 100,000 yards of style 130 XL cloth, provided that the price could be reduced to \$3.60 a yard. A commission of \$18,000 would have to be paid



to the distributor. The weaving plant at present is operating at full capacity, and if the order is accepted, a double shift will be required. This would entail a 30 percent shift premium for direct laborers. Sanders also estimates that two shifts would result in an increase in fixed overhead of \$15,000. After making the calculations shown in Exhibit II, Sanders decides to reject the order.

### Exhibit I

#### CREIGHTON MILLS, INC. Divisional Income Statement For the Year Ended December 31, 1963 (In thousands of dollars)

	Yarn division	Cloth division	Sewing division
Sales: To outsiders.....	\$ 2,200	\$5,800	\$12,600
Less: Discounts.....	80	120	600
Net sales to outsiders.....	\$ 2,120	\$5,680	\$12,000
To other divisions (at stand- ard cost plus 25%).....	3,600	4,220	-0-
Total sales.....	\$ 5,720	\$9,900	\$12,000
Standard cost of sales:			
Materials.....	\$ 1,420	\$4,200	\$ 4,800
Direct labor.....	900	1,100	2,100
Variable factory overhead....	500	400	1,050
Fixed factory overhead.....	1,300	1,800	1,000
Total.....	\$ 4,120	\$7,500	\$ 8,950
Standard gross profit.....	\$ 1,600	\$2,400	\$ 3,050
Plus or minus variances from standard:			
Raw materials prices.....	\$ (280)	-0-	\$ 60
Raw materials utilization....	50	\$ 100	(70)
Labor rates.....	(100)	-0-	-0-
Labor efficiency.....	100	50	(30)
Overhead budget variance..	(50)	40	90
Overhead volume variance..	(810)	60	(40)
Total.....	\$(1,090)	\$ 250	\$ 10
Actual gross profit.....	\$ 510	\$2,650	\$ 3,060
Less: Selling and administra- tive expenses:			
Variable*.....	\$ 240	\$ 610	\$ 800
Fixed—direct.....	210	550	670
Fixed—indirect†.....	130	340	730
Total.....	\$ 580	\$1,500	\$ 2,200
Division net profit or loss.....	\$ (70)	\$1,150	\$ 860
Units sold.....	(4,000,000 lb)	(2,500,000 yd)	(300,000 suits)

\* Variable with outside sales.

† Allocated on the basis of sales to outsiders.

*Exhibit II*

**CREIGHTON MILLS, INC.**  
**Calculation of Incremental Loss on Order**  
**From Styletex Garment Company**

	<i>Standard cost per yard style 130 XL</i>	<i>Cost of 100,000 yards</i>
Yarn (intracompany transfer price).....	\$1.50	\$150,000
Other materials.....	.20	20,000
Direct labor.....	.50	50,000
Overhead (200% direct labor).....	1.00	100,000
<b>Total.....</b>	<b>\$3.20</b>	<b>\$320,000</b>
Shift premium (30% of labor).....		15,000
Overhead applied.....		30,000
Additional fixed overhead.....		15,000
Commission.....		18,000
<b>Total costs.....</b>		<b>\$398,000</b>
Revenue.....		360,000
Loss.....		<u><u>\$ 38,000</u></u>

*Required:*

1. Do you agree with the president's comment? If not, prepare data to support your views.
2. Do you agree with Sanders' conclusion? If not, prepare a schedule to support your position.

**14-17** *Intracompany transfer prices and decision making.* The plastics department of the Little Rock Plant of the Tex-Arkana Company at present is operating at 50 percent of normal capacity. The normal overhead rate applied to products manufactured in the plastics department is \$3 per labor hour, established as follows:

	<i>Overhead rate</i>		<i>Estimated annual overhead at normal capacity (75,000 hr)</i>
	<i>Fixed</i>	<i>Variable (per hour)</i>	
Supervision.....	\$ 15,000	—0—	\$ 15,000
Indirect labor.....	28,000	\$ .40	58,000
Office salaries.....	12,000	—0—	12,000
Supplies.....	9,000	.60	54,000
Repairs.....	8,000	.52	47,000
Depreciation—machinery.....	12,000	—0—	12,000
Depreciation—building.....	6,000	—0—	6,000
Insurance and taxes.....	4,000	—0—	4,000
Utilities.....	3,000	.04	6,000
General service charge.....	11,000	—0—	11,000
<b>Total.....</b>	<b>\$108,000</b>	<b>\$1.56</b>	<b>\$225,000</b>
Rate per hour.....			3      3

The management of the Tex-Arkana Company has established a system for evaluating plant performance which treats each plant as if it were an independent unit. Each plant is permitted to purchase its parts outside the corporate organization, provided that the price is lower than if the parts were produced by another plant within the organization.

The Houston plant requires 2,000 units of a plastic part that can be manufactured at the Little Rock plant. It has advised the Little Rock plant that it has received a quotation from a reliable supplier at \$25 per unit. The cost accountant of the Little Rock plant has prepared the following estimate of the cost and price for the part, if made at his plant:

Materials.....	\$ 8.00
Labor (3.6 hr @ \$2).....	7.20
Overhead (3.6 hr @ \$3).....	10.80
Cost to make.....	<u>\$26.00</u>
Profit (15%).....	3.90
Price.....	<u>\$29.90</u>

The cost accountant points out that the Little Rock plant cannot afford to produce the part, since the outside price is lower than the cost to make at Little Rock. How much would the company lose if the part were made internally?

- 14-18 *Evaluation of salesmen.* You are acting as a consultant to the sales manager of the Empire Distributing Company, who has asked that you assist him to evaluate the efficiency of his salesmen. You have been provided with the 1962 actual sales of the five salesmen employed in the mid-Atlantic region (Exhibit I) and their direct selling expenses (Exhibit II).

### Exhibit I

#### EMPIRE DISTRIBUTING COMPANY Selling Performance—Mid-Atlantic Region For the Year Ended December 31, 1962

	Salesman				
	Anderson	Caldwell	Frederick	Moore	Samuels
Sales:					
Heaters.....	\$ 85,000	\$ 38,000	\$ 55,000	\$36,000	\$ 81,000
Vacuum cleaners.....	60,000	62,000	38,000	28,000	59,000
Can openers.....	10,000	25,000	26,000	23,000	13,000
	<u>\$155,000</u>	<u>\$125,000</u>	<u>\$119,000</u>	<u>\$87,000</u>	<u>\$153,000</u>
Percent sales potential....	(7.2%)	(8.4%)	(6.5%)	(9.2%)	(8.5%)

## Exhibit II

**EMPIRE DISTRIBUTING COMPANY**  
**Direct Selling Expenses—Mid-Atlantic Region**  
**For the Year Ended December 31, 1962**

	Salesman				
	Anderson	Caldwell	Frederick	Moore	Samuels
Salary.....	\$ 7,000	\$ 7,000	\$ 7,000	\$ 7,000	\$ 7,000
Commissions.....	7,800	6,300	6,000	4,400	7,700
Traveling.....	5,800	4,300	5,100	5,600	5,200
Entertainment and gifts.....	1,600	1,200	1,200	900	1,500
Cooperative advertising and promotions.....	6,600	6,300	6,100	5,000	6,600
Bad debts.....	700	1,600	1,200	900	400
Other.....	300	100	200	200	300
Total.....	<u>\$29,800</u>	<u>\$26,800</u>	<u>\$26,800</u>	<u>\$24,000</u>	<u>\$28,700</u>

- You have been advised that the company has the following selling standards:
1. On the basis of economic indicators, the sales potential for each selling area has been established. During 1962, each salesman was expected to realize 8.5 percent of his area's potential sales.
  2. Salesmen have been advised that the product mix that they are expected to achieve consists of heaters 25 percent, vacuum cleaners 40 percent, and electric can openers 35 percent. The standard factory cost of these products, as a percentage of selling price, is as follows:

	Heaters	Vacuum cleaners	Can openers
Selling price.....	100 %	100 %	100 %
Variable factory costs.....	42	37	40
Fixed factory costs.....	28	28	20
Total.....	70	65	60
Gross profit.....	30	35	40

3. The company has established the following standards for selling expenses:

Base salary, \$7,000 per salesman  
 Commission, 5% of sales  
 Traveling (based on area studies):  
     Anderson, \$5,200  
     Caldwell, 4,000  
     Frederick, 5,200

Moore, 5,600

Samuels, 4,800

Entertainment and gifts, 1% of sales

Cooperative advertising and promotions, 5% of sales

Bad debts,  $\frac{1}{2}$  of 1% of sales

Freight and other variable selling and administrative expenses are budgeted at 10 percent of sales.

*Required:*

1. How would you rank these salesmen, according to over-all selling effectiveness? Support your conclusion with appropriate exhibits. (Figures may be rounded to nearest \$100.)
2. Based on the company's standards, below what sales point would it be uneconomical for the company to continue to maintain a salesman? (Assume that the average traveling expenses are applicable.)

**14-19** *Responsibility for variances.* The following conversation occurred at the monthly review of operations of the Fine Furniture Corporation:

**TOM** (President): "Larry, I am disturbed to see that the factory is operating below standard. Our profit margin is very thin, and if we can't operate at standard, we're not going to make any money. What are you doing about this?"

**LARRY** (Production Manager): "I recognize that some of this inefficiency is my responsibility. I believe that we could have done a better job last month on scheduling and work assignments and am now giving more attention to these functions. However, I think these reports are quite misleading."

**JACK** (Chief Cost Accountant): "Do you mean they contain errors?"

**LARRY**: "No, as a matter of fact, I even think the standards are reasonable. What I'm driving at is that these reports imply that the person in charge of an activity necessarily is responsible for the variances. Let me be more specific. We get daily, weekly, and monthly labor efficiency reports (Exhibit I), and so I am constantly checking on unfavorable variances. Often I can find no specific reason. Perhaps the men were tired that day or were affected by the weather. Frequently, however, I discover that the inefficiency is outside my control, as, for example, excessive labor turnover, poor engineering specifications, bad assortment of lumber, and machine breakdowns. As you know, I've been asking for several machine replacements for some time. As far as labor turnover is concerned, our wage level is below the average for the area."

**TOM**: "We're short of cash and I'm reluctant to make any major expenditures for a couple of months. However, I think you've got a point about variances that may be outside your control. What about that, Jack?"

**JACK**: "It is a difficult problem. We can't establish a supreme court to decide on responsibility. However, perhaps we ought to make a greater effort to determine the causes of variances."

**LARRY**: "I can give you other examples. Look at the report for the controllable overhead of the drilling department (Exhibit II). My secretary checked all the supply charges for the month and found that the reason for the unfavorable variance is a rise in certain supply prices. Obviously, this is beyond my control. Similarly, when we set up our variable budget,



we didn't budget the wage increase which has been given to material handlers. The policy on such matters is not within my province. Repairs are particularly difficult to control, since their incurrence is unpredictable."

JACK: "There's much merit in what you say, but there is little that we in accounting can do about it. These reports never were intended to be interpreted with slide-rule accuracy."

LARRY: "The materials usage report (Exhibit III) probably bothers me the most. This month we processed an assortment filled with knotholes. I know we paid a low price for the lot, but why should I be held responsible for the low yield?"

*Required:* Evaluate the conversation. Do you think the accounting reports can be improved?

### Exhibit I

#### THE FINE FURNITURE CORPORATION Labor Efficiency Summary Month of January, 1963

Department	Actual hours	Standard hours	Variance in hours	Percent efficiency
Cutting.....	1,400	1,150	(250)	82.1
Molding.....	850	760	(90)	89.4
Drilling.....	1,600	1,400	(200)	87.5
Sanding.....	1,550	1,600	50	103.2
Packing.....	980	900	(80)	91.9
Painting.....	1,400	1,460	60	104.3
Total.....	7,780	7,270	(510)	93.4

### Exhibit II

#### THE FINE FURNITURE CORPORATION Controllable Overhead Report—Drilling For the Month of January, 1963

Expense category	Actual	Budget adjusted to actual	Actual over or (under)	Percent efficiency
Foreman.....	\$ 620	\$ 620	—0—	
Materials handlers.....	710	660	\$ (50)	
Supplies.....	1,100	910	(190)	
Power.....	125	130	5	
Repair labor.....	450	420	(30)	
Repair supplies.....	260	290	30	
Overtime premium.....	125	—0—	(125)	
Fringe benefits and payroll taxes...	210	190	(20)	
Tools.....	140	160	20	
Maintenance.....	280	260	(20)	
Total.....	\$4,020	\$3,640	\$(380)	90.5

*Exhibit III*

## THE FINE FURNITURE CORPORATION

## Materials Utilization Summary

For the Month of January, 1963

<i>Actually used at standard price</i>	<i>Standard cost of raw materials used</i>	<i>Usage variance</i>	<i>Percent efficiency</i>
<u>\$57,800</u>	<u>\$54,700</u>	<u>\$(3,100)</u>	<u>94.6</u>

14-20 *Intracompany transfer prices and performance evaluation.* Continental Processing Company maintains three plants and a sales division. The plants are located at Topeka, Syracuse, and Indianapolis. The president of the company has been striving to establish criteria for measuring performance at different operating levels. Considerable difficulty has been encountered at the plant level. In an effort to overcome these difficulties, in January, 1962, the following policy was established.

1. Return on capital employed will constitute the principal criterion for evaluating performance.
2. All interplant transfers are to be billed at the existing market price of the item. Finished goods transferred to the sales division are to be billed at selling price less 25 percent to cover the warehousing and selling costs of the sales division and permit a small profit margin on their activities.
3. If no market price exists, the billing is to be at a price which will yield the shipping plant a return on its capital equal to that which it earned during the previous quarter.

The income statement for Continental Processing Company, for the year ended December 31, 1962, appears in Exhibit I.

*Exhibit I*

## CONTINENTAL PROCESSING COMPANY

## Income Statement (not Consolidated)

For the Year Ended December 31, 1962

	<i>Topeka</i>	<i>Syracuse</i>	<i>Indian- apolis</i>	<i>Sales division</i>	<i>Total</i>
Sales:					
To outsiders.....	-0-	-0-	-0-	\$12,000,000	\$12,000,000
To sales division.....	\$3,000,000	\$1,000,000	\$ 400,000	-0-	4,400,000
To other plants.....	1,000,000	1,000,000	1,200,000	-0-	3,200,000
Total.....	<u>\$4,000,000</u>	<u>\$2,000,000</u>	<u>\$1,600,000</u>	<u>\$12,000,000</u>	<u>\$19,600,000</u>
Variable costs.....	<u>2,400,000</u>	<u>1,500,000</u>	<u>1,120,000</u>	<u>5,200,000</u>	<u>10,220,000</u>
Contribution margin.....	<u>\$1,600,000</u>	<u>\$ 500,000</u>	<u>\$ 480,000</u>	<u>\$ 6,800,000</u>	<u>\$ 9,380,000</u>
Fixed costs.....	<u>800,000</u>	<u>450,000</u>	<u>300,000</u>	<u>6,560,000</u>	<u>8,110,000</u>
Internal profit.....	<u>\$ 800,000</u>	<u>\$ 50,000</u>	<u>\$ 180,000</u>	<u>\$ 240,000</u>	<u>\$ 1,270,000</u>
Capital investment.....	<u>\$3,200,000</u>	<u>\$2,000,000</u>	<u>\$1,200,000</u>	<u>\$ 1,200,000</u>	<u>\$ 7,600,000</u>
Return on capital.....	25.0	2.5	15.0	20.0	16.7
Percent capacity.....	(90)	(60)	(70)		

Early in January, 1963, a meeting was held to review the prior year's operations and to plan for 1963. At this time, the president raised some pointed questions about the low return obtained at Syracuse. The Syracuse plant manager answered as follows:

1. He believed that there were several items at present being purchased on the outside by the Topeka plant that the Syracuse plant could make but that additional facilities would be required. However, since there was ample space, it probably would be desirable to make the change.
2. The Syracuse plant manager also contended that his plant was the newest in the company. As a consequence, his capital investment was much higher than that of the other plants and his return on capital lower. Moreover, he claimed that he obviously was not being fed enough orders by the sales division.
3. About 20 percent of the Syracuse plant's output went to Indianapolis. Since these items were highly specialized, no comparable market price existed. Pricing the items to yield a return on capital equal to the last quarter was unfair, since the Syracuse plant's return had been so low.

A discussion also developed regarding entrance into the European market. The sales manager stated that in order to penetrate this market prices would have to be reduced about 20 percent, and the plant managers refused to agree to do this, because it would lower their return on capital.

*Required:* Evaluate Continental Processing Company's system of transfer prices.

## 15. **Return on Capital and Evaluation of Performance**

There has been considerable interest in the use of return on capital investment, as a basis for measuring internal performance, during recent years. Although this has been accompanied by refinements in both theory and practice, important areas of controversy still remain.

Return on investment (ROI) equals profit divided by average capital investment. The equation may be expanded so that return on investment equals return on sales multiplied by turnover of capital, or

$$\text{ROI} = \frac{\text{profit}}{\text{sales}} \times \frac{\text{sales}}{\text{average capital investment}}$$

The latter relationship is more useful in analyzing performance, since it focuses attention on the three factors that cause changes in return on investment. They are:

1. Increases or decreases in sales
2. Increases or decreases in costs
3. Increases or decreases in capital investment

Exhibit 15-1 shows how separating the elements of return on investment facilitates analysis. It will be noted that the return on sales of the Alsob Company is identical in periods 1 and 2. If this were used solely as the criterion for evaluating performance, it would seem that the company has progressed, since the \$300,000 increase in sales has added \$30,000 of profit. Return on investment actually has declined from 15.0 to 14.3 percent. This occurred because the increase in sales in period 2 was not commensurate with the added capital investment. As a result, turnover of capital declined from 1.5 to 1.43. From period 2 to period 3, turnover of capital actually remained the same but return on investment continued to decline, from 14.3 to 13.9 percent. This is due to the drop in return on sales from 10 to 9.7 percent, caused by costs rising at a faster rate than sales. By analyzing its profit and loss statement, management can pinpoint the precise costs which rose disproportionately and plan remedial action.

The three most troublesome aspects of the return-on-investment criterion are (1) determining which assets to include in the capital-investment base, (2) selecting an appropriate asset or investment-base valua-

## Exhibit 15-1

**THE ALSOB COMPANY**  
Operating Data—Periods 1, 2, and 3

	<i>Period 1</i>	<i>Period 2</i>	<i>Period 3</i>
Sales.....	\$6,000,000	\$6,300,000	\$6,435,000
Costs.....	\$5,400,000	\$5,670,000	\$5,810,000
Profit.....	\$ 600,000	\$ 630,000	\$ 625,000
Capital.....	\$4,000,000	\$4,400,000	\$4,500,000
Return on sales.....	10.0%	10.0%	9.7%
Capital turnover.....	1.5	1.43	1.43
Return on capital.....	15.0%	14.3%	13.9%

tion, and (3) allocating asset investment to plants, divisions, product lines, or other internal sectors.

#### Assets to be included in the capital-investment base

The assets included in the capital-investment base, for return-on-investment calculations, should be directly related to the income derived from their use, and both the assets and income should be under the control of the sector manager. General corporate assets such as security investments, intangibles, and nontrade receivables should be excluded from the investment base of divisions, plants, and product lines, unless they can be directly identified with the sector. An internal sector also should not be charged with allocated costs or given credit for revenue not directly earned, such as interest, dividends, and abnormal gains (or losses). When return on investment is calculated for an entire company, instead of an internal sector, all corporate assets and all income derived from their use are relevant.

Assets, such as receivables, inventories, and directly used fixed assets, generally can be easily identified with an internal sector. However, as return on investment is calculated for lower activity levels, the direct assets become smaller in magnitude and the indirect assets proportionately greater, as shown below:

<i>Activity level</i>	<i>Direct assets</i>	<i>Indirect assets</i>
Corporate.....	All assets	-0-
Division.....	Division cash, receivables, inventories, and fixed assets	Corporate cash and fixed assets
Plant.....	Plant cash, receivables, inventories, and fixed assets	Corporate and division cash and fixed assets
Product line.....	Product-line receivables, inventories, and specialized fixed assets	Corporate, division, and plant cash and fixed assets



The treatment of assets under construction and idle facilities is controversial. It can be argued that assets under construction should be excluded from the investment base, since revenue cannot be derived until completion of construction. This fails to recognize that an internal sector should be penalized for committing funds that might otherwise be productive. Idle facilities should be included in the investment base if the inactivity of these assets is due to a division's not attaining its budgeted share of the actual market or is caused by improper maintenance.

### Selecting the capital-investment-base valuation

Assets may be included in the capital-investment base at (1) acquisition cost, (2) book value, i.e., acquisition cost less allowances for depreciation, (3) book value of assets less current liabilities, and (4) book value of assets less total liabilities, i.e., accounting net worth. Each of these methods has its advocates.

The effect on return on investment of the use of these different bases may be illustrated by assuming that a company, earning an annual profit before taxes of \$48,000, has the following balance sheet. For simplicity, it will be assumed that the company has a single plant and product line.

<i>Assets</i>		<i>Liabilities and stock equities</i>	
Net current assets .....	\$300,000	Current liabilities ....	\$100,000
Fixed assets .....	\$800,000	5% bonds payable ...	300,000
Less: allowance for depreciation .....	300,000	Stock equities .....	400,000
	<u>500,000</u>		
	<u>\$800,000</u>		<u>\$800,000</u>

### Use of acquisition cost of assets

When the acquisition cost of assets is used as the basis for determining the return on capital, no recognition is given to accumulated depreciation. Under this method, in the illustrative data, a yield of 4.4 percent is realized (\$48,000/\$1,100,000). Proponents of this method believe that it tends to make the results of different operating divisions or plants somewhat more comparable, since it diminishes the effect of different depreciation methods and the use of new versus old assets at different locations.

E. I. du Pont de Nemours & Company, which has pioneered in the use of return on investment for measuring internal performance, uses the gross value of its assets as its investment base. The company's reasons for adopting this procedure are partially explained in the following statement:<sup>1</sup>

Gross operating investment represents all the plant, tools, equipment and

<sup>1</sup> E. I. du Pont de Nemours & Company, Treasurer's Department, Executive Committee Control Charts (New York: American Management Association, 1960).

working capital made available to operating management for its use; no deduction is made for current or other liabilities or for the reserve for depreciation. Since plant facilities are maintained in virtually top productive order during their working life, the depreciation reserve being considered primarily to provide for obsolescence, it would be inappropriate to consider that operating management was responsible for earning a return on only the net operating investment. Furthermore, if depreciable assets were stated at net depreciated values, earnings in each succeeding period would be related to an ever-decreasing investment; even with stable earnings, return on investment would continually rise, so that comparative Return on Investment ratios would fail to reveal the extent or trend of management performance. Relating earnings to investment that is stable and uniformly compiled provides a sound basis for comparing the profitability of assets employed as between years and investments.

In the case of any commitment of capital—e.g., an investment in a security—it is the expectation that in addition to producing earnings while committed, the principal will eventually be recovered. Likewise in the case of funds invested in a project, it is expected that in addition to the return earned while invested, the working capital will be recovered through liquidation at the end of the project's useful life and the plant investment will be recovered through depreciation accruals. Since earnings must allow for this recovery of plant investment, they are stated net of depreciation.

There are, of course, many different viewpoints among businessmen as to how Return on Investment should be computed for different purposes. It is the purpose of the Du Pont chart series to seek to present as clearly as possible the results produced by operating management. The capital, liability and reserve positions of an enterprise are largely a reflection of the philosophy of top management as to how the business should be financed. The Du Pont Company believes that operating management should be responsible for turning in a profit on capital assigned to that management, regardless of how capital was raised.

Although this argument is not without merit, it is not entirely convincing. Failure to reduce the capital asset base by accumulated depreciation tends to produce a diminishing rate of return. This occurs because even if an asset's productivity does not decline because of diligent maintenance, profits still diminish as a consequence of rising maintenance costs incurred to avert this drop in productivity.

Advocates of this method contend that the use of acquisition cost tends to offset the effect of the declining value of the dollar. For this point of view to be acceptable, the annual decline in monetary values, as applied to fixed assets, would approximately have to equal annual provisions for depreciation. There is no logical basis for this supposition. If book values do not represent real economic values because of the declining value of the dollar or because of inaccurately computed depreciation, this can be dealt with only by using the replacement value of the assets.

### Use of book value of assets

The use of the book value of assets, i.e., acquisition cost less allowances for depreciation, as the investment base in the illustration yields a return of 6 percent ( $\$48,000/\$800,000$ ). This method may be defended on the following grounds: (1) in the absence of monetary fluctuations and asset appreciation, book value of fixed assets has greater economic significance than acquisition cost, since it recognizes that a portion of the fixed asset cost has been recovered through depreciation charges against revenue and that a gradual decline in fixed asset values normally occurs as a consequence of wear and tear and obsolescence; and (2) book values conform to published financial reports and thus are understood more readily by executives.

The principal criticisms leveled against the use of the book values of assets as the investment base are (1) that it does not coincide with the return-on-investment calculations made by financial analysts and investors; these individuals are concerned with the return on net capital investment, i.e., book value of assets less total liabilities; (2) that it does not lend itself to interdivision and interplant comparisons, where the problem of old versus new and leased versus owned fixed assets exists; and (3) that if a significant disparity exists between the book value of assets and their replacement cost, the economic significance of the resulting return-on-investment figures becomes questionable.

The use of book value of assets is most effective in comparisons of a single operating sector with its own performance of prior years or against an established "target." It is most vulnerable when used for interdivision or interplant comparisons. In such comparisons, only the economic value of the capital employed has significance.

Few companies presently attempt to adjust the book value of their assets to replacement cost. This reluctance primarily can be attributed to skepticism regarding the reliability of statistical indices and to a hesitancy to depart from accepted standards of financial reporting. The fact that the accounting profession, as well as regulatory agencies, has adhered to original cost does not deny the merits of, or bar the use of, replacement cost for internal reporting.

Price index statistics do not produce economic values. This transpires only through the exchange process in a free market. However, price indices do reflect monetary changes, which are a major factor in the difference between acquisition and replacement cost of fixed assets. It is to be hoped that as more experience is gained with the use of price index statistics, they will become more refined and more acceptable, at least for internal purposes.

### Use of book values of assets less current liabilities

The use of the book value of assets less current liabilities, as the investment base, also has been advocated. The inclusion of current liabilities

in the investment base emphasizes the return on total long-term capital provided by bondholders, mortgagors, and stockholders. It shows the extent to which the corporation is able to meet its long-term interest and dividend obligations. In order to disclose this information, it first is necessary to add back bond interest expense to reported income. In the illustration, this results in an increase in income from \$48,000 to \$63,000 and a return on long-term capital of 9 percent ( $\$63,000/\$700,000$ ). If the illustrative company plans to pay a 5 percent dividend to its stockholders, a 4 percent return on long-term capital will be available for growth, as indicated below:

		<i>Percent of total long-term capital provided (\$700,000)</i>
Reported income plus bond interest.....	\$63,000	9.0
Less: Bond interest and dividend payments.....	<u>35,000</u>	<u>5.0</u>
Available for growth.....	\$28,000	4.0

In defense of this method, it may be argued that current liabilities are offset against current assets in the calculation of a company's working capital. However, for evaluating internal performance, only the revenue-producing assets at the disposition of the operating unit have significance. The method is more useful for external financial analysis than for internal evaluations of performance.

### Use of book value of assets less total liabilities

Book value of assets less total liabilities is equal to net capital, net worth, "net assets," or stockholders' equity of a corporation. In the illustration, this method yields a return of 12 percent ( $\$48,000/\$400,000$ ). This method is of particular interest to present and prospective stockholders and is widely used in external analysis. It is less useful for internal performance evaluation, since the capital base does not consist exclusively of revenue-producing net assets.

The desirability of including only net assets in the capital base, for internal measurements, does not preclude the use of other bases for other purposes, e.g., reports to stockholders. However, the use of multiple investment bases requires a reconciliation, so that the various targets are coordinated. An illustration of this type of reconciliation appears later in this chapter.

### NAA study of use of capital-investment bases

In a study of 44 companies using the return-on-investment criterion,<sup>2</sup> the National Association of Accountants provides some indication of the types of investment base being used in practice, as shown in Exhibit 15-2.

<sup>2</sup> Return on Capital as a Guide to Managerial Decisions, National Association of Accountants, Research Report 35, New York, 1959, p. 8.



**Exhibit 15-2**

**Investment Base Used in Evaluating Past Performance  
For a Company as a Whole**

<i>Investment base</i>	<i>Number of companies reporting use of each base</i>
Total assets available.....	28
Total assets employed (i.e., excess or idle assets eliminated).....	4
Stockholders' equity plus long-term debt.....	6
Stockholders' equity.....	7
Total.....	45*

\* The total exceeds the number of companies interviewed because some companies use more than one base for computing rate of return. Of the 28 companies using "Total assets available," 18 deducted accumulated depreciation.

**Allocation of asset investment**

Another complicating aspect of the return-on-investment method is its apparent dependence upon allocation techniques. As one proceeds from higher to lower company levels in efforts to measure performance, more refinements in allocation techniques become necessary. Nevertheless, in spite of allocation difficulties, the ultimate objective of this method often is the computation of return on investment for product lines and even individual products.

Allocation techniques are familiar to the trained accountant. The actual cash at each location is known. Home-office cash generally is allocated to plants on the basis of sales or cost of sales. Accounts receivable normally can be segregated specifically by division or plant without difficulty, or they may be allocated on the basis of sales. Inventories and some fixed assets can be identified directly with a plant or division. Other fixed assets such as research facilities, trucking, home-office building, and equipment, may be allocated to plants and divisions on the basis of estimated services performed.

The extent to which allocation techniques may be employed is shown in the following illustration adapted from the procedure used by a leading American paper company. The balance sheet of this company, which we will call The Jones Paper Company, as of December 31, 1963, appears in Exhibit 15-3.

All fixed assets appearing in Exhibit 15-3 are stated on the balance sheet at cost less accumulated depreciation. The company has four divisions, which include six plants and two large timber tracts. An income statement is prepared for each of these operating units. The condensed income statement for plant B of the paper, board, and converting division is shown in Exhibit 15-4. It will be observed that income also is computed for each cost center in plant B. In the paper industry a cost center



## Exhibit 15-3

**THE JONES PAPER COMPANY**  
 Balance Sheet as of December 31, 1963  
 (In thousands of dollars)

<i>Assets</i>		<i>Liabilities and equities</i>	
Cash.....	\$ 15,100	Accounts payable.....	\$ 34,000
Receivables.....	20,900	Taxes payable.....	2,000
Inventories.....	20,000	Other payables.....	500
Total current assets.....	\$ 56,000	Total current liabilities..	\$ 36,500
Land.....	7,600	Bonds payable.....	100,000
Houses and lots.....	1,300	Stock outstanding.....	300,000
Wood-processing equipment..	5,400	Undistributed earnings....	95,700
Pulp mills.....	168,800		
Paper and board mills.....	212,100		
Chlorine plants.....	4,400		
Water supply systems.....	3,200		
Steam systems.....	3,500		
Electrical power systems...	2,700		
General service facilities...	1,900		
Cartage and cranes.....	1,200		
Chemical plants.....	8,300		
Woodland buildings and equipment.....	2,900		
Timberlands (net).....	16,800		
Converting operations.....	10,800		
Construction in progress...	19,100		
Research and development..	4,600		
Central transportation.....	1,600		
Total.....	\$532,200	Total.....	\$532,200

often represents a huge investment and thus becomes the focal point for profit analysis and control.

The capital investment for each plant is determined as shown in Exhibit 15-5. The plant capital investment is then assigned to machine centers, as illustrated in Exhibit 15-6 for plant B. The capital investment is assigned to product lines in the following manner:

1. The actual annual hours of machine operation is determined for the past year (Exhibit 15-7, column 3).

2. The capital investment per hour for each machine center is computed by dividing the capital investment for each machine center by its total annual hours of operation (Exhibit 15-7, column 4).

3. The average hourly tonnage produced by each machine center, by product lines, is then determined from the plant records (Exhibit 15-7, column 6).

4. The capital investment per ton produced (Exhibit 15-7, column 7)

## Exhibit 15-4

## THE JONES PAPER COMPANY—PLANT B

## Income Statement

Year Ended December 31, 1963

(In thousands of dollars)

<i>Product line</i>	<i>Sales</i>	<i>Costs and expenses</i>	<i>Income after tax</i>
Machine center A1:			
a	\$ 8,400	\$ 7,900	\$ 500
b	15,200	14,500	700
Total.....	\$ 23,600	\$ 22,400	\$1,200
Machine center A2:			
c	\$ 21,600	\$ 20,800	\$ 800
d	17,200	16,100	1,100
e	36,000	33,900	2,100
Total.....	\$ 74,800	\$ 70,800	\$4,000
Machine center A3:			
f	\$ 8,500	\$ 8,200	\$ 300
g	21,600	20,700	900
Total.....	\$ 30,100	\$ 28,900	\$1,200
Machine center A4:			
h	\$ 11,700	\$ 11,000	\$ 700
i	9,800	9,400	400
Total.....	\$ 21,500	\$ 20,400	\$1,100
Total plant B.....	\$150,000	\$142,500	\$7,500

is calculated by dividing the machine investment per hour by the hourly production.

5. The capital investment for the tonnage sold during the year is determined by multiplying the investment per ton produced by the number of tons sold (Exhibit 15-7, column 12). It will be observed that the total capital investment assigned to the tons sold by plant B (\$57,209,000) is greater than the actual capital investment at the close of the year (\$55,600,000). This is due to the fact that more tons were sold than were produced, resulting in a decline in the year-end inventory as compared to the opening inventory.

### Multiple capital investment bases

The type of information revealed in Exhibit 15-7 is useful for judging the long-run profitability of product lines, machine centers, plants, and divisions. However, in appraising operating efficiency, only assets directly under the control of an executive should be charged to him, since alloca-

## Exhibit 15-5

**THE JONES PAPER COMPANY**  
Allocation of Capital Investment to Divisions  
(In thousands of dollars)

Asset classification	Basis of allocation	Total investment*	Mercantile paper, plant A	Paper, Board, and Converting			Chemicals		Timberlands	
				Plant B	Plant C	Plant D	Plant E	Plant F	Region X	Region Y
<b>Direct plant:</b>										
Land.....	Direct	\$ 7,600	\$ 500	\$ 1,600	\$ 3,000	\$ 1,400	\$ 400	\$ 700	-0-	-0-
Houses and lots.....	Direct	1,300	-0-	300	800	200	-0-	-0-	-0-	-0-
Wood-processing equip.....	Direct	5,400	-0-	-0-	-0-	-0-	-0-	-0-	\$ 3,300	\$ 2,100
Pulp mill.....	Direct	168,800	16,300	10,300	81,800	44,300	5,800	10,300	-0-	-0-
Paper and board mill.....	Direct	212,100	11,700	16,100	184,300	-0-	-0-	-0-	-0-	-0-
Chlorine plant.....	Direct	4,400	-0-	-0-	3,200	-0-	1,200	-0-	-0-	-0-
Water supply equip.....	Direct	3,200	200	800	900	900	200	200	-0-	-0-
Steam equip.....	Direct	3,500	200	1,000	600	1,300	200	200	-0-	-0-
Electricity equip.....	Direct	2,700	500	-0-	2,100	-0-	-0-	100	-0-	-0-
General service facilities.....	Direct	1,900	200	400	400	600	100	200	-0-	-0-
Cartage and cranes.....	Direct	1,200	100	200	400	400	100	-0-	-0-	-0-
Chemical plants.....	Direct	8,300	-0-	-0-	-0-	-0-	4,100	4,200	-0-	-0-
Woodlands bldg. and equip.....	Direct	2,900	-0-	-0-	-0-	-0-	-0-	-0-	1,600	1,300
Timberlands (net).....	Direct	16,800	-0-	-0-	-0-	-0-	-0-	-0-	8,700	8,100
Converting oper.....	Direct	10,800	-0-	-0-	-0-	10,800	-0-	-0-	-0-	-0-
Const. in progress.....	Direct	19,100	6,000	12,000	1,100	-0-	-0-	-0-	-0-	-0-
<b>Total direct.....</b>		<b>\$470,000</b>	<b>\$35,700</b>	<b>\$42,700</b>	<b>\$278,600</b>	<b>\$59,900</b>	<b>\$12,100</b>	<b>\$15,900</b>	<b>\$13,600</b>	<b>\$11,500</b>
<b>Allocated plant:</b>										
Research and development.....	Specific projects	4,600	100	300	1,400	400	1,100	1,300	-0-	-0-
N.Y. transportation.....	Estimated divisional loads	1,600	100	400	700	300	100	-0-	-0-	-0-
<b>Gross plant investment.....</b>		<b>\$476,200</b>	<b>\$35,900</b>	<b>\$43,400</b>	<b>\$280,700</b>	<b>\$60,600</b>	<b>\$13,300</b>	<b>\$17,200</b>	<b>\$13,600</b>	<b>\$11,500</b>
<b>Working funds:</b>										
Inventories.....	Direct	20,000	500	3,600	5,700	4,300	1,100	800	1,800	2,200
Accounts receivable.....	Direct	20,900	600	5,000	3,300	10,300	1,200	500	-0-	-0-
Cash.....	Direct and cost of sales	15,100	200	3,600	2,700	6,800	800	400	300	300
<b>Total investment.....</b>		<b>\$532,200</b>	<b>\$37,200</b>	<b>\$55,600</b>	<b>\$292,400</b>	<b>\$82,000</b>	<b>\$16,400</b>	<b>\$18,900</b>	<b>\$15,700</b>	<b>\$14,000</b>

\* In this illustration, the capital investment at the close of the year was used. More accurate results would be obtained by using the average annual investment.

Exhibit 15-6

THE JONES PAPER COMPANY  
Allocation of Plant B Investment to Machine Centers  
(In thousands of dollars)

Asset classification	Basis of allocation	Total plant B investment [Exhibits 15-4, 15-5]	Machine center A1	Machine center A2	Machine center A3	Machine center A4
Land.....	Area occupied by machines	\$ 1,600	\$ 800	\$ 200	\$ 300	\$ 300
Houses and lots.....	Area occupied by machines	300	150	38	56	56
Wood-processing equip.....	Projected tons of pulp per machine	-0-	-0-	-0-	-0-	-0-
Pulp mill.....	Projected tons of pulp per machine	10,300	2,120	5,530	1,325	1,325
Paper and board mill.....	Actual	16,100	5,400	3,300	3,700	3,700
Chlorine plant.....	Projected consumption of bleached pulp	-0-	-0-	-0-	-0-	-0-
Water supply equip.....	Projected capacity of machine	800	320	80	200	200
Steam equip.....	Projected consumption of steam per machine	1,000	500	100	200	200
Electricity equip.....	Projected consumption of electricity per machine	-0-	-0-	-0-	-0-	-0-
General service facil.....	Formula	400	150	50	100	100
Cartage and cranes.....	Machine capacity	200	80	20	50	50
Chemical plants.....	Direct	-0-	-0-	-0-	-0-	-0-
Woodlands bldg. and equip.....	Direct	-0-	-0-	-0-	-0-	-0-
Timberlands (net).....	Direct	-0-	-0-	-0-	-0-	-0-
Converting.....	Nature of project	12,000	4,800	1,200	3,000	3,000
Construction in progress.....	Specific project	300	-0-	300	-0-	-0-
Research and development.....	Machine capacity	400	160	40	100	100
N.Y. transportation.....	Traceable to machines	3,600	1,200	1,800	300	300
Inventories.....	Traceable to machines	5,000	2,500	500	1,000	1,000
Accounts receivable.....	Cost of machinery	3,600	1,660	280	830	830
Cash.....						
Total.....		\$55,600	\$19,840	\$13,438	\$11,161	\$11,161

Exhibit 15-7

THE JONES PAPER COMPANY—PLANT B  
Data Supporting Return on Investment on Machine Centers and Product Lines  
Year Ended December 31, 1963

(1) Machine center	(2) Machine center investment (Exhibit 15-6), in M of dollars	(3) Annual hours of production	(4) Machine center investment per hr (col. 2 ÷ col. 3)	(5) Product line	(6) Average tonnage produced per hr	(7) Investment per ton produced (col. 4 ÷ col. 6)	(8) Tons sold, in M	(9) Sales, in M of dollars	(10) Costs and expenses, in M of dollars	(11) Income after tax, in M of dollars		(12) Capital investment in ton sold, in M of dollars (col. 8 × col. 7)		(13) Return on investment	
										Product line	Machine center	Product line	Machine center	Product line (col. 11 ÷ col. 12)	Machine center (col. 11 ÷ col. 12)
A1	\$19,840	2,200	\$9,018	a	140	\$ 64.41	150	\$ 8,400	\$ 7,000	\$ 500	\$1,200	\$9,662	\$18,680	5.2%	6.4%
A2	13,438	2,000	6,719	b	70	128.83	70	15,200	14,500	700		9,018		7.7	
				c	140	47.99	60	21,600	20,800	800		2,875		27.8	
				d	50	134.38	40	17,200	16,100	1,100		5,375		20.5	
A3	11,161	2,000	5,580	e	100	67.19	100	36,000	33,900	2,100	4,000	6,719	14,969	31.2	26.6
				f	150	37.20	200	8,500	8,200	300		7,440		4.0	
				g	90	62.00	80	21,600	20,700	900	1,200	4,966	12,400	18.1	9.7
A4	11,161	2,000	5,580	h	100	55.80	120	11,700	11,000	700		6,696		10.5	
				i	50	111.60	40	9,800	9,400	400	1,100	4,464	11,160	9.0	9.9
Total.....							860	\$150,000	\$142,500		\$7,500		\$57,209		



## Exhibit 15-8

**PLASTIC PRODUCTS CORPORATION**  
**Target Return on Capital Employed and Stockholders' Investment**  
**For Year Ended December 31, 1963**

	<i>Directly applicable to divisions</i>	<i>Not directly applicable to divisions</i>	<i>Applicable to company</i>	<i>Stockholders' investment</i>
Budgeted capital:				
Cash.....	\$ 1,000,000	\$ 2,000,000	\$ 3,000,000	
Receivables.....	17,000,000	—0—	17,000,000	
Inventories.....	40,000,000	—0—	40,000,000	
Fixed assets (net).....	82,000,000	8,000,000	90,000,000	
Other assets.....	—0—	10,000,000	10,000,000	
Total.....	\$140,000,000	\$20,000,000	\$160,000,000	\$160,000,000
Less: Corporate liabilities.....				30,000,000
Stockholders' investment.....				\$130,000,000
Budgeted income:				
Sales.....	\$150,000,000	—0—	\$150,000,000	
Cost of sales.....	90,000,000	—0—	90,000,000	
Gross profit.....	\$ 60,000,000	—0—	\$ 60,000,000	
Less: Expenses directly chargeable to divisions.....	30,000,000	—0—	30,000,000	
Direct division profit.....	\$ 30,000,000	—0—	\$ 30,000,000	
Less: Expenses not directly chargeable to divisions.....		\$15,000,000	15,000,000	
Budgeted income.....			\$ 15,000,000	\$ 15,000,000
Budgeted return on capital.....	21.4%		9.4%	
Financial leverage.....			1.23	
Budgeted return on stockholders' investment.....				11.5%

tions cloud the issue and become centers of controversy. This can be accomplished without losing sight of the over-all company return-on-investment objective by developing a system of coordinated targets as shown in Exhibit 15-8. In order to meet its dividend obligations and provide for growth, the Plastic Products Corporation has established a budgeted return on stockholders' equity of 11.5 percent. To achieve this

target, each division on the average would have to earn a 21.4 percent return on its direct capital.

### The financial-leverage factor

Financial leverage may be expressed as

$$\frac{\text{Total capital employed}}{\text{Stockholders' investment}}$$

Financial leverage indicates the extent to which the capital assets of a corporation have been derived from stockholders, as contrasted with creditors. The Plastic Products Corporation's budgeted return on stockholders' investment of 11.5 percent is derived by dividing the budgeted income by the stockholders' equity. It also may be obtained by multiplying return on capital employed by the financial leverage factor ( $.094 \times 1.23$ ).

Financial leverage adds another dimension to the analysis of return on stockholders' investment, as shown below:

$$\frac{\text{Return on capital employed}}{\frac{\text{Profit}}{\text{Sales}} \times \frac{\text{sales}}{\text{capital employed}} \times \frac{\text{capital employed}}{\text{stockholders' investment}}} = \text{Return on stockholders' investment}$$

A corporation can improve its return on stockholders' investment, not only by raising its return on sales and capital turnover rate, but also by increasing its financial leverage. In the case of the Plastic Products Corporation, the financial leverage is low. If the company had obtained a larger portion of its capital funds from creditors, the financial leverage would have been greater and the return on stockholders' investment higher. There are, of course, financial risks and restraints that prevent a corporation from depending excessively on creditors for capital funds. An interesting example of the use of financial leverage in practice appears in Fig. 15-1.

### The variability of capital

The objective of profit planning is the realization of a budgeted return on capital investment. This requires a predetermination of capital at the forecast level of operations. Certain capital, e.g., fixed assets, remains relatively constant, regardless of the level of activity. Other capital, e.g., accounts receivable, varies directly with sales. A third category of capital, e.g., cash, is partly fixed and partly variable. A minimum cash balance is required to maintain even an inactive plant, but as output rises, the cash requirements increase. An indication of the variability of

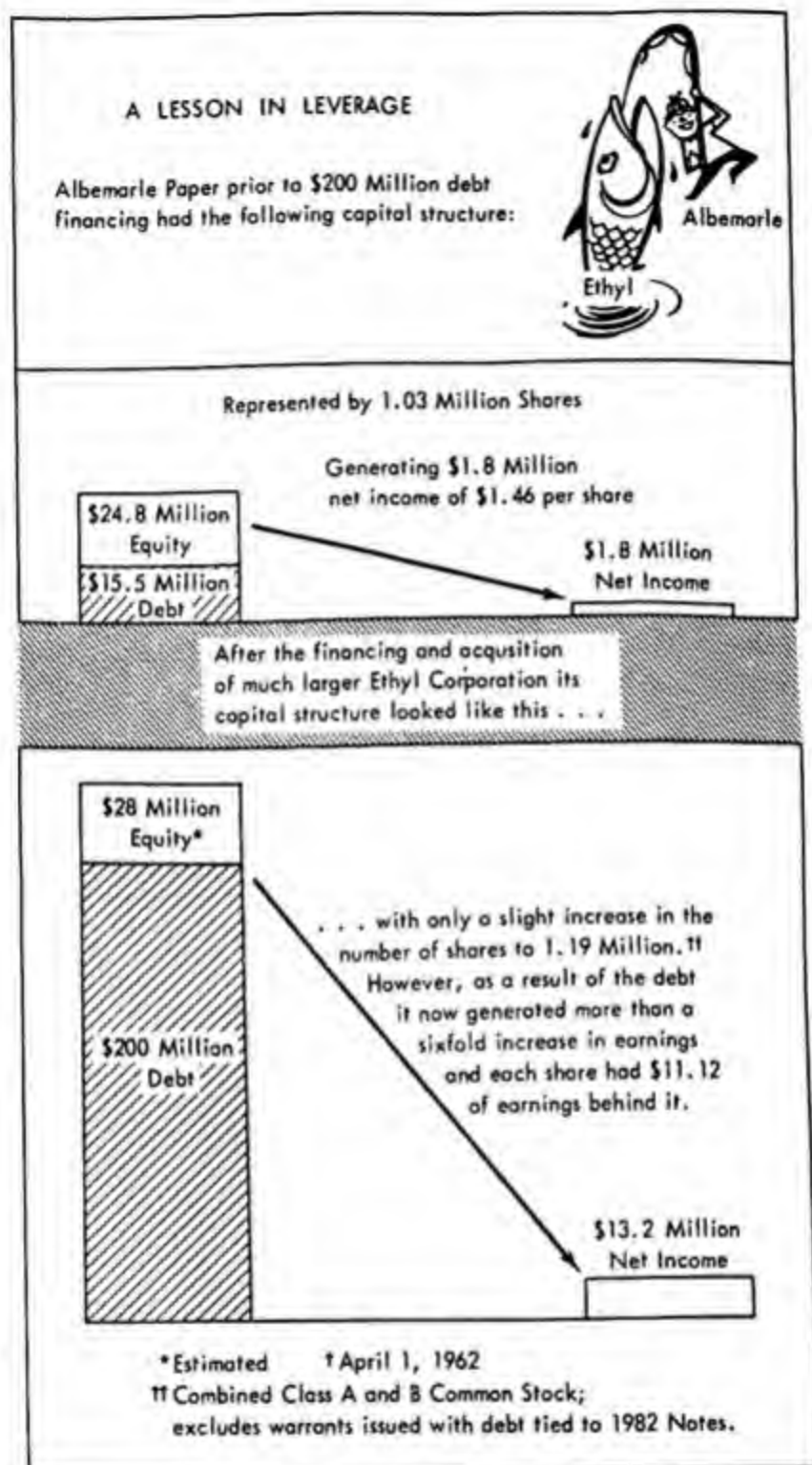


Fig. 15-1 An example of leverage. (*Forbes*, December 1, 1962, p. 15.)

capital assets can be obtained from past experience. Not only does capital vary at different operating levels, but it varies differently for different operating units. Exhibit 15-9 shows how the budgeted capital may be computed for two product lines in the same company.

It now is possible to compute the capital requirements for the two

*Exhibit 15-9***Determination of Product-line Capital Requirements at the Budgeted Level of Operations**

	<i>Product line A (sales budget \$530,400)</i>		<i>Product line B (sales budget \$982,800)</i>	
	<i>Fixed capital</i>	<i>Variable capital, % of sales</i>	<i>Fixed capital</i>	<i>Variable capital, % of sales</i>
Cash.....	\$ 5,000	4.71%	\$ 5,000	3.56%
Receivables.....	-0-	16.96	-0-	10.17
Inventories.....	-0-	33.93	-0-	25.44
Fixed Assets.....	600,000	-0-	660,000	-0-
Total.....	\$605,000	55.60	\$665,000	39.17

product lines. At the budgeted level, the annual average investment for product line A is  $\$605,000 + (.556 \times \$530,400)$ , or  $\$900,000$ , and for product line B,  $\$665,000 + (.3917 \times \$982,800)$ , or  $\$1,050,000$ .

### **Variable budgeting of return on investment and analysis of variances**

The effect of volume generally has been ignored in the literature on return on investment. Yet, failure to recognize the volume influence on the results obtained can lead to erroneous impressions regarding operating performance. In Exhibit 15-10, it is assumed that operating conditions for Division A of the Lunanjon Corporation were identical in periods 1, 2, and 3, except for the rise in sales, and that variable costs and capital are perfectly variable with sales.

Three of the basic criteria for measuring the performance of an operating unit—return on sales, capital turnover, and return on capital—all show steady and marked improvement. It would seem that the manager of this division should be commended. However, these improvements occurred entirely as a consequence of the increase in volume and despite a disproportionate rise in variable costs and capital, two presumably controllable elements. Even the increase in sales may not be completely praiseworthy, since consideration should be given to the sales potential for Division A's products.

The principles of variable budgeting can be applied to return-on-investment analysis. In Exhibit 15-11, it is assumed that Division A's performance is being measured against the indicated operating budget or profit plan. We now get a different impression of Division A's per-

## Exhibit 15-10

THE LUNANJON CORPORATION—DIVISION A  
Operating Data  
Periods 1, 2, and 3

	Period 1		Period 2		Period 3	
	Amount	Percent of sales	Amount	Percent of sales	Amount	Percent of sales
Sales.....	\$1,000,000	100.0	\$1,500,000	100.0	\$2,000,000	100.0
Variable costs.....	\$ 600,000	60.0	\$1,000,000	66.7	\$1,400,000	70.0
Fixed costs.....	300,000	30.0	300,000	20.0	300,000	15.0
Total costs.....	\$ 900,000	90.0	\$1,300,000	86.7	\$1,700,000	85.0
Income.....	\$ 100,000	10.0	\$ 200,000	13.3	\$ 300,000	15.0
Fixed capital employed.....	\$ 500,000	50.0	\$ 500,000	33.3	\$ 500,000	25.0
Variable capital employed.....	300,000	30.0	500,000	33.3	700,000	35.0
Total capital employed.....	\$ 800,000	80.0	\$1,000,000	66.6	\$1,200,000	60.0
Return on sales.....	10.0%		13.3%		15.0%	
Turnover of capital.....	1.25		1.5		1.66	
Return on capital.....	12.5%		20.0%		25.0%	

formance. The division actually has performed unsatisfactorily, assuming that the budget represents a good attainable target. Exhibit 15-11 also contains an analysis of the causes for the unfavorable variance, in return on capital, of 15.5 percent.

In order to isolate the elements contributing to the variance of 15.5 percent in return on capital employed shown in Exhibit 15-11, we must first assume that the actual capital used equals the budgeted capital. Accordingly, in calculating the effect of not attaining the sales budget, we divide the profit leakage, that is,  $\$200,000 - (.65)(\$200,000)$ , by the budgeted rather than actual capital. Similarly, the effect of excessive costs, that is,  $\$1,400,000 - (.65)(\$2,000,000)$ , is divided by budgeted capital. On the other hand, in calculating the consequence of actual capital employed exceeding budgeted capital, we use the budgeted income rather than actual income.

This type of variance analysis can be greatly expanded, so that the effect of each favorable or unfavorable element of the variance is disclosed to management, for example, materials price variance, materials usage variance, labor efficiency variance, etc. The analysis of profit plan variations is discussed in greater detail in the next chapter.



## Exhibit 15-11

**THE LUNANJON CORPORATION—DIVISION A**  
**Comparison of Actual Operating Data with Budget**  
**Period 3**

	Actual		Budget		Variance
	Amount	Percent of sales	Amount	Percent of sales	
Sales .....	\$2,000,000	100.0	\$2,200,000	100.0	-\$200,000
Variable costs .....	\$1,400,000	70.0	\$1,430,000	65.0	\$30,000
Fixed costs .....	300,000	15.0	300,000	13.6	-0-
Total costs .....	\$1,700,000	85.0	\$1,730,000	78.6	\$30,000
Income .....	\$300,000	15.0	\$470,000	21.4	-\$170,000
Fixed capital employed .....	\$500,000		\$500,000		-0-
Variable capital employed .....	700,000	35.0	660,000	30.0	-\$40,000
Total capital employed .....	\$1,200,000		\$1,160,000		-\$40,000
Return on sales .....	15.0%		21.3%		
Turnover of capital .....	1.67		1.9		
Return on capital .....	25.0%		40.5%		-15.5%

	Percent
<i>Analysis of variances:</i>	
Due to operating below budget volume, $\$200,000 - (.65)(\$200,000)/$ \$1,160,000 .....	6.0
Due to excessive costs, $\$1,400,000 - (.65)(\$2,000,000)/\$1,160,000$ .....	8.6
Due to excessive capital employed, $(\$300,000/\$1,160,000) - (\$300,000/$ \$1,200,000) .....	.9
Total .....	15.5

**The relationship between divisional performance and incremental return on investment**

Another troublesome aspect of return-on-investment analysis is the relationship between the present performance of a highly successful operating unit and its incentive for new capital investments. In most multi-division companies, some divisions and plants are substantially more successful than others, and there is a wide difference between returns on capital employed. Some of these operating units are realizing a return well above the company's average; others are achieving a below-average return.

Under these circumstances, let us suppose that a successful division is considering a capital-investment proposal which would yield a return below its present performance but above the over-all company average. From the division's standpoint, it is preferable to reject this proposal,

## Exhibit 15-12

**THE ELFRED CORPORATION—DIVISION A**  
**Operating Data for the Year Ended December 31, 1962**  
**After Giving Effect to Proposed New Investment**

	<i>Operating data</i>	<i>Proposed capital investment</i>	<i>Operating data after giving effect to proposed investment</i>
Sales.....	\$1,000,000	\$200,000	\$1,200,000
Variable costs.....	\$ 500,000	\$100,000	\$ 600,000
Fixed costs.....	300,000	60,000	360,000
Total costs.....	\$ 800,000	\$160,000	\$ 960,000
Income.....	\$ 200,000	\$ 40,000	\$ 240,000
Capital employed.....	\$ 667,000	\$160,000	\$ 827,000
Return on capital.....	30.0%	25.0%	29.0%

## Exhibit 15-13

**ELFRED CORPORATION—DIVISION A**  
**Income Statement**  
**Year Ended December 31, 1963**

Sales.....	\$1,200,000
Costs and expenses.....	960,000
Actual income.....	\$ 240,000
Add: Incentive allowed on incremental investments.....	8,000
Income after allowed incentive.....	\$ 248,000
Capital employed.....	\$ 827,000
Actual return on capital.....	29.0%
Return on capital after allowed incentive.....	30.0%

since it would create a downward trend in its return on capital. An opposite result occurs for the company as a whole. In Exhibit 15-12, Division A of the Elfred Corporation would be less than enthusiastic about the incremental investment, since its return on total capital employed would decline from 30.0 to 29.0 percent. However, if we assume that the Elfred Corporation's over-all pretax return on capital is 20 percent, this is a desirable investment.

What can be done to overcome this type of internal conflict? One possibility is to provide a successful division or plant with an incentive to bring the prospective returns on such incremental investments up to its present return. The incentive would apply only to the specific situation described. It would be calculated at the time the proposal is approved, and each year during the life of the asset a journal entry such as the following would be recorded. The entry would be eliminated when the company's books are consolidated.

(Debit, on corporation books)	
Incentive Given on Incremental Investments—Division A . . . . .	8,000
(Credit, on Division A's books)	
Incentive Received on Incremental Investments . . . . .	8,000

If we assume that Division A's present performance remains unchanged during 1963 and that the new investment earns exactly what was predicted, Division A's income statement at the close of 1963 might appear as shown in Exhibit 15-13.

### Summary

Return on investment represents one of the most promising techniques for evaluating performance. It has been used fruitfully by some companies for a number of years. Nevertheless, it possesses certain limitations:

First, there are several conflicting theories as to the proper basis for evaluating investment. Although only a handful of companies presently use replacement cost, this represents the most logical basis for asset valuation.

Second, most companies charge sectors with direct and allocated costs and assets. This is not compatible with performance evaluation. In measuring performance, only controllable profit elements and capital are relevant.

Third, the return-on-investment method tends to create conflicts between the interests of an internal sector whose return on investment is above average and that of the company as a whole.

Fourth, the return-on-investment method generally relates net profit to capital investment. In the short-run, the emphasis should be on marginal profit rather than net profit.

Fifth, return on investment creates a tendency to rent or lease rather than purchase property. Yet, in the long run, ownership of property may be more advantageous to a company.

These problems raise challenging questions regarding the merits of return on investment. The future use of this form of measurement largely depends on the success achieved in solving these problems.

## Problems and cases

- 15-1 *Return on capital employed in performance measurement.* "Return on capital employed constitutes the most advanced technique yet developed by accountants for measuring plant and division performance. If applied correctly, it is virtually flawless." Comment.
- 15-2 *Allocation of capital.* A large manufacturing company uses return on capital employed for measuring internal performance, including that of product lines. All capital assets appearing on the company's balance sheet are allocated to

the product lines. What items would normally be allocated, and how should this be accomplished? What are the disadvantages to this procedure?

- 15-3 *Return on capital: Interplant comparisons.* The tube division of the American Radio and Television Corporation has four plants. The return on capital employed at the Detroit plant is substantially lower than that for the other plants. As a consequence, a change in plant management at Detroit is under consideration. If you were the present manager of the Detroit plant, what arguments would you present to indicate that it is not fair to compare the return at your plant with that of the other plants?
- 15-4 *Financial leverage.* Why is a company's financial leverage important in return-on-investment analysis? Why may it be necessary to budget a company's financial leverage? How can this be accomplished?
- 15-5 *Segregating elements in return on stockholders' investment.* How can return on stockholders' investment be broken down for purposes of analysis? What advantages are obtained from isolating these elements?
- 15-6 *Factors causing change in return on stockholders' investment.* The return on the stockholders' investment of the Full-Flavor Corporation has declined sharply from one year to another. List all the factors that might have caused this decline.
- 15-7 *Return on capital: Interplant comparisons.* "Return on capital gives us the only intelligent basis for comparing the results of different divisions." What problems are encountered in such comparisons?
- 15-8 *Assets to be included in capital-investment base.* What type of problems arise in determining which assets to include in the capital-investment base?
- 15-9 *Company levels and return-on-capital measurement.* "The higher the company level, the more precise is the return-on-investment calculation." Comment.
- 15-10 *Return on capital: use of acquisition cost of assets.* Many corporations ignore allowances for depreciation in calculating return on capital. What justification is there for this procedure? Does it have any limitations?
- 15-11 *Return on capital: use of book values of assets.* What principal criticisms can be leveled against the use of the book value of assets in return-on-capital analysis?
- 15-12 *Plant return-on-capital measurement*  
DIVISION MANAGER: "Since my performance is judged on the basis of return on capital, I have every right to judge my plant managers on the same basis."  
PLANT MANAGER: "I can't agree with you. I think the situation is not quite the same."  
Comment.
- 15-13 *Return on capital in short-run decisions.* Plant manager of highly automated plant: "We calculate the capital investment per machine hour and use it in deciding which order to accept when we are operating at full capacity."  
Comment.



- 15-14** *Reconciling division and company returns.* Explain how direct return on direct capital at the division level can be reconciled with total return on stockholders' investment.
- 15-15** *Importance of variability of capital.* Why is it important to give consideration to the variability of capital in return-on-capital analysis?
- 15-16** *Budgeted return on capital and analysis.* Return on capital may be budgeted and deviations from the budget analyzed in a manner similar to deviations from the profit plan. Discuss.
- 15-17** *Conflicts between division and company objectives.* The return on capital of one division of a company has been substantially higher than that of other divisions. The division manager follows the practice of approving only those new capital investments which will bring in an estimated return in excess of the division's current return. What conflicts does this policy introduce? Can you suggest a way to overcome the problem?
- 15-18** *Purchase or rent.* Division manager: "Confidentially, our return on capital is higher than that of other divisions because I have learned how to play this game. I never buy equipment when I can rent or lease it." Evaluate this comment, both from the division and the company standpoint.
- 15-19** *Accounting for changes in return on stockholders' investment.* At the close of its business year, a corporation showed the following results:

Income:	
Sales (100,000 units @ \$50).....	\$5,000,000
Variable costs.....	3,000,000
Contribution to fixed costs and profit.....	\$2,000,000
Fixed costs.....	1,700,000
Income.....	<u>\$ 300,000</u>
Capital:	
Variable capital.....	\$2,000,000
Fixed capital.....	4,000,000
Total capital employed.....	\$6,000,000
Liabilities.....	1,200,000
Stockholders' investment.....	<u>\$4,800,000</u>

*Required:*

- What will the return on stockholders' investment be at the close of the year (on the assumption that the investment remains constant), if a 5 percent reduction in price occurs, a 10 percent rise in units sold, and a 20 percent increase in financial leverage? Variable costs and variable capital may be assumed to vary with sales.
- On the assumption that the price remains constant, how many units must be sold to achieve a 10 percent return on capital employed?
- What sales are required for the company to earn 10 percent on the capital employed if direct-labor costs, which at present are equal to 20 percent of sales, are increased 5 percent, fixed costs rise by \$100,000, and fixed capital by \$300,000?



- 15-20 *Causes for variance between actual and budgeted return on investment.* The following data represent a comparison between the actual results and the budget for a company producing and selling a single product:

	Actual	Budget
Sales (units).....	(95,000)	(100,000)
(amount).....	\$969,000	\$1,000,000
Cost of sales—at standard.....	\$581,400	\$ 600,000
Plus: Variances from standard.....	19,600	—0—
Cost of sales.....	\$601,000	\$ 600,000
Gross profit.....	\$368,000	\$ 400,000
Less: Selling and administrative expenses.....	329,000	320,000
Net profit before taxes.....	\$ 39,000	\$ 80,000
Capital employed.....	\$450,000	\$ 400,000
Stockholders' investment.....	\$270,000	\$ 250,000

From the foregoing data, prepare a report showing all possible reasons for the variance between the budgeted and actual return on stockholders' investment.

- 15-21 *Alternative return-on-investment methods.* The Nu Shoe Company has two divisions, ladies' footwear and men's footwear. The men's footwear division has two plants, one in Lynn and one in Brockton. The ladies' footwear division plant is in St. Louis. The company's condensed balance sheet as of June 30, 1963, and its condensed income statement for the year ended June 30, 1963, are presented below:

**NU SHOE COMPANY**  
Condensed Balance Sheet  
As of June 30, 1963

Current assets.....	\$1,200,000
Fixed assets.....	\$5,400,000
Less: Allowance for depr'n.....	2,400,000
Total assets.....	\$4,200,000
Current liabilities.....	\$ 600,000
Long-term liabilities.....	900,000
Stockholders' investment.....	2,700,000
Total liabilities and equity.....	\$4,200,000

**NU SHOE COMPANY**  
Condensed Income Statement  
Year Ended June 30, 1963

Revenue.....	\$2,400,000
Costs.....	1,960,000
Income.....	\$ 440,000

The company computes return on investment for each plant and division as the basis for evaluating performance. In order to have the plants' and divisions' return on the same basis as that for the company as a whole, indirect assets, liabilities, revenue, and costs are allocated to divisions and plants.

The controller's analysis of the relevant data and the basis used by him for allocations are shown below:

	Brockton	Lynn	St. Louis
Current assets—direct.....	\$ 500,000	\$ 200,000	\$ 300,000
—indirect.....	(On basis of direct current assets)		
Fixed assets—direct.....	2,000,000	1,000,000	1,000,000
—allowance for depr'n...	(600,000)	(700,000)	(500,000)
—indirect.....	(On basis of direct fixed assets)		
Current liabilities—direct.....	200,000	100,000	200,000
—indirect.....	(On basis of direct current liabilities)		
Long-term liabilities—indirect.....	(On basis of current liabilities)		
Revenue—direct.....	800,000	400,000	800,000
—indirect.....	(On basis of direct revenue)		
Costs—direct.....	650,000	390,000	720,000
—indirect.....	(On basis of direct revenue)		

**Required:**

1. On the basis of the company's procedure, calculate the return on investment for each division and plant.
2. Evaluate the method used.
3. Calculate the direct return on direct capital used for each division and plant.
4. Compare the results of (3) with (2), and evaluate the second method used.

**15-22**

*Measuring the profitability of machine centers.* Mid West Printing is a division of the Continental Business Machine Corporation. Mid West's plant contains two producing departments, one with New Era presses and one with Rotary presses. The New Era department occupies three times as much factory space as the Rotary department. In order to evaluate the performance of its several divisions, Continental permits them to operate as independent units, to the extent possible.

All Mid West's orders (checks, accounting forms, punch cards, etc.) are received from Continental's Supply Sales division. Mid West bills Continental monthly for the actual cost of all jobs completed, including materials, labor, factory overhead, selling, and administrative expenses and a profit margin equal to \$1 per direct-labor hour. Selling and administrative expenses are included at 20 percent of the factory cost of completed jobs. The latter expenses are incurred by Continental on behalf of Mid West and are charged to Mid West at the 20 percent rate at the close of each month. Billings by Continental's Supply Sales division to its customers tend to be approximately equal to its charges from Mid West. The income statement for Mid West for the year ended December 31, 1962, appears in Exhibit I.

The average annual capital required at the Mid West Printing plant is shown in Exhibit II. Accounts Receivable represents the average unpaid balance of Continental's billings to its customers.

**Required:**

1. a. Which department was more profitable in 1962?  
b. Suppose that the New Era department had 20 percent unused capacity in 1962, whereas the Rotary department was operating at full capacity. Which department is potentially more profitable?  
c. In evaluating the performance of the Mid West Printing plant, how

*Exhibit I*

**MID WEST PRINTING DIVISION**  
**Income Statement**  
**For the Year Ended December 31, 1962**

	<i>Total</i>	<i>New Era press department</i>	<i>Rotary press department</i>
Sales.....	\$2,630,000	\$1,620,000	\$1,010,000
Less: Cost of sales			
Materials.....	\$ 499,400	\$ 206,000	\$ 293,400
Direct labor.....	489,600	312,000*	177,600*
Variable overhead.....	290,000	200,000	90,000
Fixed overhead.....	721,000	502,000	219,000
Total.....	<u>\$2,000,000</u>	<u>\$1,220,000</u>	<u>\$ 780,000</u>
Gross profit.....	\$ 630,000	\$ 400,000	\$ 230,000
Less: Charge for selling and administrative expenses.....	400,000	244,000	156,000
Profit before income taxes.....	<u>\$ 230,000</u>	<u>\$ 156,000</u>	<u>\$ 74,000</u>
Return on sales.....	(8.7%)	(9.6%)	(7.3%)

\* Average rate per hour: New Era, \$2; Rotary, \$2.40.

*Exhibit II*

**MID WEST PRINTING DIVISION**  
**Average Capital Required**

<i>Capital</i>	<i>Fixed</i>	<i>Variable</i>
Cash.....	-0-	.10 (variable factory costs + selling and administrative expenses)
Accounts receivable.....	-0-	.20 sales
Inventories.....	-0-	.30 materials used
Machinery—New Era.....	\$680,000	-0-
—Rotary.....	200,000	-0-
Land and building.....	880,000	-0-

can we avoid holding plant management responsible for the effect on profit of low operating levels?

2. Do you think the pricing policy is consistent for the two departments?
3. Suppose that an order is received that can be produced in either department and that capacity is available in both departments. To which department should it be assigned? (Assume that running time on the order will be the same in either department.)
4. Suppose that the plant is operating at full capacity and that management has funds available for one additional press. Should a Rotary or a New Era press be purchased?

**15-23**

*Evaluation of division performance.* The American Kitchen Equipment Company has three divisions: stoves, dishwashers, and refrigerators. Each of these product lines is manufactured in a separate plant. All three plants and the company's executive office building are located in Pittsburgh. The dishwasher plant is substantially smaller than the other plants because of the lower sales

## Exhibit I

AMERICAN KITCHEN EQUIPMENT COMPANY  
 Divisional Return on Capital Investment  
 For the Year Ended December 31, 1962  
 (In thousands of dollars)

	Basis of allocation	Stoves	Dish- washers	Refriger- ators	Total company
Income:					
Sales.....		\$10,000	\$6,500	\$9,900	\$26,400
Cost of sales.....		6,400	4,400	6,300	17,100
Gross profit.....		<u>\$ 3,600</u>	<u>\$2,100</u>	<u>\$3,600</u>	<u>\$ 9,300</u>
Less: selling and administrative expenses					
Direct:					
Division management.....		\$ 80	\$ 70	\$ 70	\$ 220
Division accounting.....		50	30	60	140
Selling.....		960	580	800	2,340
Advertising and promotion...		140	100	150	390
Freight out.....		200	140	250	590
Total.....		<u>\$ 1,430</u>	<u>\$ 920</u>	<u>\$1,330</u>	<u>\$ 3,680</u>
Allocated:					
Combined selling.....	Sales	\$ 910	\$ 590	\$ 900	\$ 2,400
General advertising.....	Sales	60	30	60	150
Company management.....	Sales	75	50	75	200
Company administration.....	Sales	65	40	65	170
General.....	Sales	60	30	60	150
Total.....		<u>\$ 1,170</u>	<u>\$ 740</u>	<u>\$1,160</u>	<u>\$ 3,070</u>
Total selling and administrative expenses.....		<u>\$ 2,600</u>	<u>\$1,660</u>	<u>\$2,490</u>	<u>\$ 6,750</u>
Net profit before income taxes.....		<u>\$ 1,000</u>	<u>\$ 440</u>	<u>\$1,110</u>	<u>\$ 2,550</u>
Return on sales.....		(10.0%)	(6.8%)	(11.2%)	(9.6%)
Capital investment (average annual):					
Direct					
Cash.....		\$ 20	\$ 15	\$ 25	\$ 60
Receivables.....		900	410	990	2,300
Inventories.....		1,800	850	2,100	4,750
Assets under construction.....		-0-	300	-0-	300
Machinery and equipment.....		1,400	600	2,000	4,000
Plant.....		2,300	700	3,000	6,000
Total.....		<u>\$ 6,420</u>	<u>\$2,875</u>	<u>\$8,115</u>	<u>\$17,410</u>
Allocated:					
Cash.....	Cost of sales	\$ 190	\$ 130	\$ 180	\$ 500
Marketable securities.....	Direct investment	110	50	140	300
Investments in affiliated companies.....	Direct investment	700	300	900	1,900
Warehouses.....	Sales	460	300	440	1,200
Delivery equipment.....	Sales	38	25	37	100
Administration building.....	Sales	190	125	185	500
Total.....		<u>\$ 1,688</u>	<u>\$ 930</u>	<u>\$1,882</u>	<u>\$ 4,500</u>
Total capital employed.....		<u>\$ 8,108</u>	<u>\$3,805</u>	<u>\$9,997</u>	<u>\$21,910</u>
Less: Liabilities.....	Capital employed	2,590	1,210	3,210	7,010
Stockholders' investment.....		<u>\$ 5,518</u>	<u>\$2,595</u>	<u>\$6,787</u>	<u>\$14,900</u>
Return on investment.....		(18.1%)	(17.0%)	(16.3%)	(17.1%)
Turnover of investment.....		(1.8)	(2.5)	(1.5)	(1.8)



volume and because to a larger extent dishwasher parts are fabricated by suppliers.

Each division maintains its own sales force to handle the accounts of large customers. In addition, company salesmen, handling all three product lines, solicit orders from smaller customers.

The president has been attempting to evaluate the performance of the three divisions. In past years, return on sales has been the principal criterion. On this basis, for the year 1962, the dishwasher division with a return of 6.8 percent appears to be the least profitable division and the refrigerator division, with a return of 11.2 percent, the most profitable. However, the president is not convinced that return on sales constitutes a satisfactory basis for measuring divisional performance. He has requested the controller to calculate the return on capital investment for each division and to present the data at top management's annual review of operations. At this meeting, the controller distributes copies of Exhibit I to each member present. The following discussion ensues:

CONTROLLER: "It would seem apparent that we have been drawing erroneous conclusions regarding divisional performance by relying on return on sales. After giving effect to the capital investment applicable to each division, it is clear that, although the refrigerator division has the highest return on sales, it also has the lowest return on its capital investment and that the return on investment earned by dishwashers is about equal to that for the company as a whole, despite a comparatively low return on sales. This is due to the fact that our capital investment per dollar of sales is lowest in dishwashers and highest in refrigerators."

REFRIGERATOR DIVISION MANAGER: "I find it difficult to understand the manner in which you have charged me with allocated capital. For example, just because my direct investment is higher than the other divisions', why should I be socked with a heavier allocated portion of the company's marketable securities and investments in affiliated companies? This hardly seems fair."

CONTROLLER: "I have tried to use the most logical basis available for these allocations."

PRESIDENT: "What about warehouses, delivery equipment, and the administration building? Sales hardly seem the most appropriate basis for allocating these items. I would think that frequency of movement and size of items would affect the use of delivery equipment and warehouse space. As for the administration building, I must admit I'm lost."

STOVE DIVISION MANAGER: "Somehow, it also doesn't seem correct to deduct liabilities on the basis of the total investment. Aren't most of the liabilities related to operating costs rather than investment?"

DISHWASHER DIVISION MANAGER: "While we are on the subject of allocations, I would like to question the allocation of combined selling expenses on the basis of sales. As you know, for the past 2 years our dishwashers have been meeting less sales resistance than stoves or refrigerators. I am convinced that company salesmen are spending proportionately more time and effort selling stoves and refrigerators than dishwashers. I also think that our division has required less technical assistance from the company's executive staff than the other divisions. One last point—do you think it is right for me to be charged with \$300,000 of assets under construction before I can earn my income from them?"



REFRIGERATOR DIVISION MANAGER: "Well now, if we are going to question the allocation of expenses, I'd like to point out that our average order is a good deal larger than the other divisions'. I would think this would result in less accounting and clerical costs per dollar of sales."

PRESIDENT: "I'm beginning to wonder whether return on investment is any more precise than return on sales. Isn't there any way of calculating return on investment without all these allocations?"

CONTROLLER: "Let me think about this some more, and perhaps I can come up with a better procedure."

REFRIGERATION DIVISION MANAGER: "Before we drop this subject, I'd like to mention that my plant is the newest in the company and my capital investment therefore is relatively higher than the other divisions'."

Required:

1. Comment on the discussion.
2. Could the controller have avoided much of the controversy by a better system of allocation? If so, what specific improvements would you suggest?
3. Could a report be prepared which would avoid dependence on allocations? If so, prepare one, and indicate its advantages and limitations.

15-24 The Pioneer Electric Corporation has three divisions, for which the operating results for the year ended December 31, 1963, are shown below.

**PIONEER ELECTRIC CORPORATION**  
Divisional Income Statement  
For the Year Ended December 31, 1963  
(In thousands of dollars)

	Wire division	Decorative division	Lamp division
Sales.....	\$6,500	\$4,400	\$3,800
Less: Cost of sales			
Materials—from wire division.....	-0-	\$ 910	\$ 210
Materials—from outsiders.....	\$2,600	660	750
Direct labor.....	1,270	700	650
Variable overhead.....	400	300	400
Fixed overhead.....	1,200	540	500
Total.....	\$5,470	\$3,110	\$2,510
Less: Cost of wire transferred internally.....	1,120	-0-	-0-
	\$4,350	\$3,110	\$2,510
Gross profit.....	\$2,150	\$1,290	\$1,290
Less: Selling and administrative expenses			
Direct—variable.....	\$ 975	\$ 480	\$ 520
Direct—fixed.....	638	315	464
Central administration (basis of sales).....	290	195	165
Total.....	\$1,903	\$ 990	\$1,149
Division net profit.....	\$ 247	\$ 300	\$ 141
Capital employed:			
Direct—variable (with sales).....	25 %	15 %	20 %
Direct—fixed.....	\$3,083	\$ 240	\$ 110
Allocated (basis of sales).....	884	600	516

Wire transferred to the decorative and lamp divisions would have earned a gross profit of 30 percent if sold externally. No selling and administrative expenses are incurred on internally transferred wire. Division managers' salaries are retained on a private payroll and are included in the central administration expenses. They are as follows: wire \$35,000, decorative \$22,000, and lamp \$21,000.

*Required* (where necessary, prepare exhibits to support your answers):

1. Which division was most profitable in 1963, in aggregate and per dollar of sales?
2. Which division made the largest contribution to the company's working capital in 1963, in aggregate and per dollar of sales?
3. Assume that all divisions are operating at full capacity and that the company has only a limited amount of funds available for expansion. If 1963 results are regarded as typical of future years, which of the three divisions should be expanded?
4. Which division manager performed most efficiently in 1963?
5. From the standpoint of performance evaluation, what weaknesses do you find in the reporting system?

## 16. **Profit Planning and Analysis of Gross Profit Variation**

### *The profit plan*

An integrated budget program consists of a profit plan, profit improvement plan, cash flow projection, and capital-investment budget. The interrelationship among these plans is illustrated in Fig. 16-1.

The profit plan, or operating budget, is a projection of a company's profit expectations for a specified period of time. It is supported by a series of linked subbudgets for major elements of profit, e.g., sales, cost of sales, selling expenses, and for functional activities, e.g., selling, manufacturing, purchasing, research.

The profit plan should be regarded primarily as a planning instrument and should include expected leakages from performance standards, such as anticipated raw materials price variances, labor rate variances, and unabsorbed factory overhead. Performance standards, e.g., standard costs, variable budgets, sales potentials, and return on invested capital, are the indices used for measuring performance. The profit improvement plan is designed to eliminate leakages which account for failure to meet performance standards.

### **Profit planning and human relations**

Top-management participation in the planning effort is essential. Frequently, this is achieved through an executive planning committee, consisting of officers of the company. The compilation of the plan may be entrusted to a budget director or profit-planning coordinator, performing a staff function.

The profit plan should not represent a strait jacket imposed on the organization by its top management. It should be established with the full participation of the individuals responsible for its attainment. Adequate authority should be delegated to these individuals.

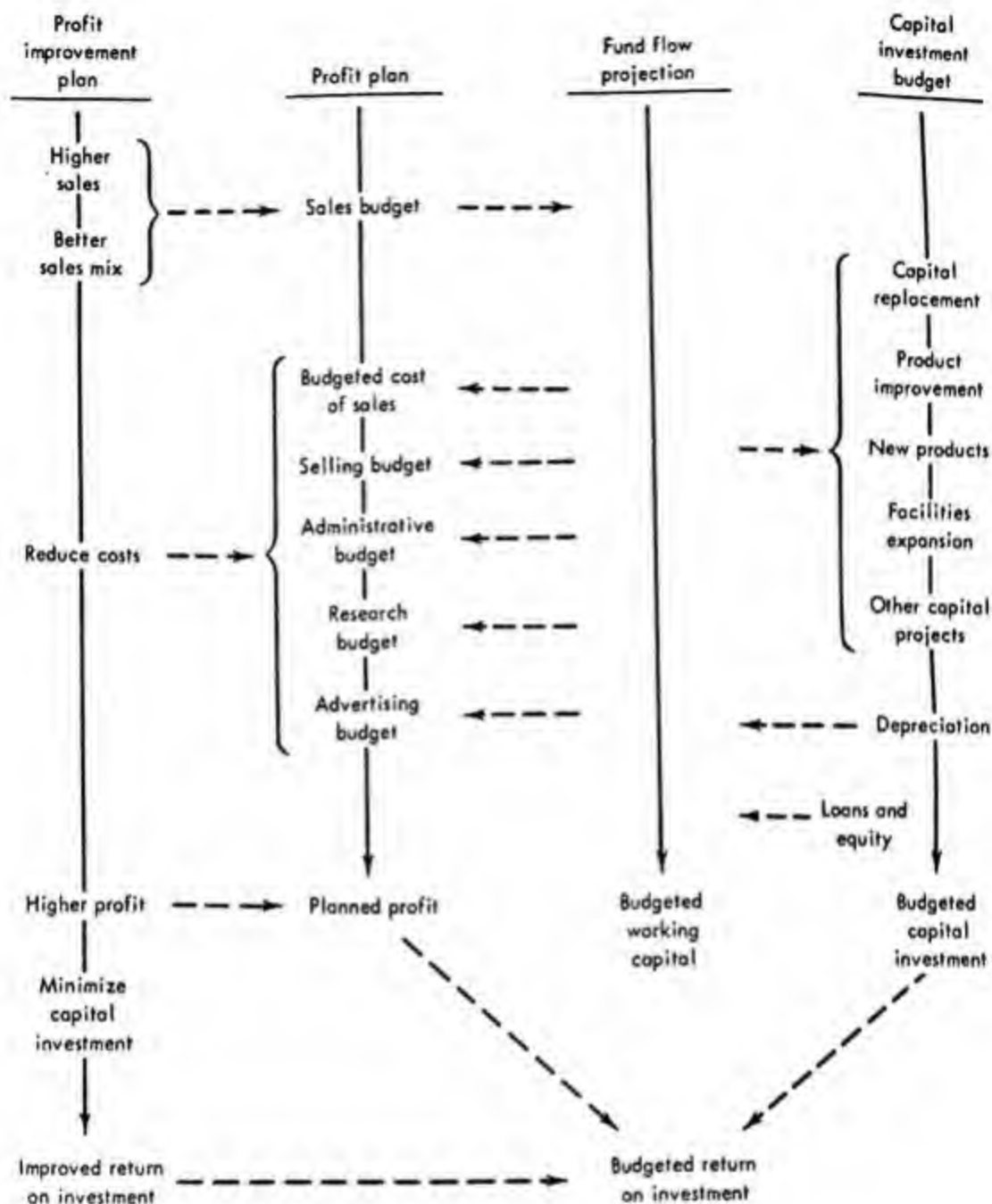


Fig. 16-1 The budget program.

### The planning period

The profit plan may be established once a year, or it may be adjusted throughout the year on a moving basis, as shown below:

Fixed profit plan: 1/1 —————> 12/31

Moving profit plan: 1/1 —————> 12/31

4/1 —————> 3/31

7/1 —————> 6/30

10/1 —————> 9/30

A moving profit plan is more realistic, since the frequency of its preparation permits consideration of changing economic factors. The frequent changes would seem to diminish its control features. However, it should be remembered that the *performance standards* constitute the basic criteria for evaluating performance.

### The sales budget

The sales forecast is the fulcrum on which all phases of the profit plan hinge. Forecasting sales is fraught with uncertainty. Sales are affected by a multitude of factors, including pricing policies, the degree of inter- and intra-industry competition, disposable income, buyer attitudes, appearance of new products, and economic conditions. Nevertheless, many large companies have developed refined forecasting techniques and are able regularly to achieve a sales realization of 97 or 98 percent. Responsibility for establishing the sales budget rests with the sales department. The forecasting may take place at different company levels, as shown by the flow of sales forecasting data below:

Level of activity	Data used
Company level	Proposed advertising expenditures New-products report Facilities available National economic trends
Division level	Trend analysis Correlation analysis Motivation research Order backlog
District level	Market potentials
Customer level	Salesmen's estimates

#### Trend analysis

There are three types of sales trends that have significance for purposes of prediction: secular, or long-term, trends; cyclic trends; and seasonal trends.

Secular, or long-term, trends may be calculated by plotting sales data on a moving-average basis. Cyclic trends reflect the pressure of business cycles on sales. They can be plotted by computing the percent of deviation between the long-term trend and the actual annual sales. Secular and cyclic trends are of value in long-term sales projections.

Virtually every business is subject to some seasonal variation in sales. The seasonal trend can be determined by plotting monthly sales for several years and showing how they vary from the monthly average for each year. It would be naïve to assume that sales trends automatically



will continue in the same direction and at the same rate of growth. For purposes of prediction, past sales trends are virtually useless at economic turning points or when market conditions are changing rapidly. The probable continuation of a trend must be inferred from the logic of the situation. If a company recently has introduced an improved product, it may be assumed that its share of the market will continue to grow until competitors can retaliate. A past sales trend may even produce an opposite trend in the near future.

For example, in the durable goods industry, heavy sales during the recent past may have saturated the market and may cause a slack in demand in the near future. The greatest benefit to be derived from sales trend analysis occurs when it is used in conjunction with correlation analysis, evaluation of market potentials, and executive judgments regarding competition, new products, advertising, etc.

### Economic indicators and correlation analysis

An economic indicator is a statistical index (independent variable) which is closely correlated with another index (dependent variable) and may be used to predict values for the latter. The problem in forecasting is to discover which indicators are relevant, to determine their reliability, and to ascertain whether they lead or lag behind the dependent index. In the following list an example of an economic indicator is given for each industry:

<i>Industry</i>	<i>Indicator</i>
Gasoline, tires, batteries	Automobiles in circulation
Oil rigs	New wells drilled
Food sales	Population and income per family
Baby carriages	Birth rate
College textbooks	Students
Automobiles	Disposable income per family unit
Steel	Industrial output

The relationship between two or more indices can be measured by means of correlation analysis. The relationship may be linear (straight line) or curvilinear (curved line). A linear relationship exists when the rate of change between the two indices is essentially constant. A curvilinear relationship occurs when the rate of change varies at different magnitudes. It often is desirable to plot the relationship between the two variables graphically. The line which provides the best fit for these variables is known as the *regression line*. It may be used as the basis for predicting values for the dependent variable.

From a mathematical standpoint, the closeness of correlation between a dependent variable and one or more independent variables is expressed by the *coefficient of determination*. The coefficient of determination measures the affinity between two series of data by determining the extent to

which the regression line accounts for the total random variation which would have occurred in the absence of a regression line.

Changes in the dependent variable often cannot be adequately explained by a single independent variable. The demand for a particular product may be affected by advertising, by price of product, and by the level of disposable income, as well. When the variations in the dependent variable can be explained best by two or more independent variables, multiple correlation may be employed. Multiple correlation analysis is an extension of simple correlation, although the mathematical computations may be considerably more involved. Multiple correlation analysis often can be dispensed with, since the introduction of additional independent variables may produce only slightly smaller increases in the correlation obtained.

### Motivation research

During recent years, special market research techniques, referred to as *motivation research*, have been developed for measuring consumer motivation. This approach leans heavily upon the behavioral sciences, particularly psychology, sociology, and anthropology. Motivation research relies upon methods developed by Sigmund Freud and others to explore the subconscious motives of buyers. It uses a number of techniques, including "thematic apperception," "paired pictures," "word association," and "depth interviews." While it is still too early to evaluate motivation research, there are indications that it will play an increasingly important role in sales forecasting and in decisions relating to advertising and product design.

### Salesmen's estimates

Many companies require their salesmen to prepare annual estimates of product sales, since they are most familiar with local conditions and customer potentials. The salesmen's estimates are combined at the district level and related to the statistical forecasts. Salesmen's estimates stimulate the salesmen's interest in budgeting. They serve as a check against statistical forecasts. They provide a basis for pinpointing variations between actual and budgeted sales. However, these estimates should be reviewed carefully, since the results are apt to be biased in one direction or another, depending upon the expected use of the data.

### The Tire Company—sales budget

In order to illustrate the preparation of a profit plan, a case study is presented. The data relates to a mythical tire company, which produces and distributes three different types of tires within a single country. The Tire Company's actual sales from 1957 through 1962 and its projected sales for the budget year 1963 are shown in Exhibit 16-1.

## Exhibit 16-1

**THE TIRE COMPANY**  
**Product Sales, 1957 to 1963**  
(In millions of dollars)

Year	Total sales	Product X		Product Y		Product Z	
		Sales	Percent of total	Sales	Percent of total	Sales	Percent of total
1957	\$ 5.3	\$ 2.1	39.6%	\$ 2.1	39.6%	\$1.1	20.8%
1958	10.5	3.5	33.3	4.6	43.8	2.4	22.9
1959	16.3	6.2	38.0	7.2	44.2	2.9	17.8
1960	19.8	8.3	41.9	8.8	44.5	2.7	13.6
1961	24.0	8.7	36.3	10.9	45.4	4.4	18.3
1962	27.4	9.3	34.0	12.3	45.0	5.8	21.0
1963*	31.1	10.3	33.1	13.9	44.8	6.9	22.1

\* Projected.

## Exhibit 16-2

**THE TIRE COMPANY**  
**Computation of Tire Sales per Car in Circulation, 1957-1963**

Years	(1) Cars in circulation, in thousands	(2) Actual sales, total tire industry, in millions dollars	(3) Tire sales per car
1957	510.3	\$ 42.1	\$82.5
1958	613.4	51.1	83.3
1959	744.0	61.9	83.2
1960	879.5	73.0	83.0
1961	1,051.4	88.0	83.7
1962	1,190.2	100.1	84.1
1963*	1,330.0	113.1	85.0

\* Projected.

The sales forecast for 1963 is based on the estimated number of automobiles in circulation, tire sales per automobile, and the company's estimated share of the total tire market. These statistics appear in Exhibits 16-2 and 16-3.

The Tire Company's budgeted sales for 1963 was calculated as follows:

I. Column 3 of Exhibit 16-2 indicates that a close correlation exists be-

tween the number of cars in circulation and the sales of tires. The gradual rise in tire sales per car is due to price increases.

2. The number of cars expected to be in circulation during the budget year of 1963 (1,330,000) was determined from data published by the automotive industry.

3. Tire sales per car in circulation during 1963 were expected to be

Exhibit 16-3

**THE TIRE COMPANY**  
Percentage of Total Industry Sales, 1957 to 1963

Year	(1) Total industry sales, in millions of dollars	(2) Tire Company sales, in millions of dollars	(3) Tire Company percent of total industry sales
1957	\$ 42.1	\$ 5.3	12.6%
1958	51.1	10.5	20.5
1959	61.9	16.3	26.3
1960	73.0	19.8	27.1
1961	88.0	24.0	27.3
1962	100.1	27.4	27.4
1963*	113.1	31.1	27.5

\* Projected.

Exhibit 16-4

**THE TIRE COMPANY**  
1963 Monthly Sales Budget  
(In thousands of dollars)

Month	Monthly sales as percent of total	Total sales	Sales, product X (unit price, \$25)		Sales, product Y (unit price, \$20)		Sales, product Z (unit price, \$30)	
			Units	Amount	Units	Amount	Units	Amount
January.....	5.8%	\$ 1,804	23.8	\$ 597	40.3	\$ 806	13.3	\$ 401
February.....	5.8	1,804	23.8	597	40.3	806	13.3	401
March.....	7.4	2,301	30.5	762	51.4	1,029	17.0	510
April.....	8.5	2,644	35.0	876	59.0	1,181	19.5	587
May.....	9.0	2,799	37.1	927	62.6	1,251	20.7	621
June.....	9.6	2,986	39.6	989	66.7	1,334	22.1	663
July.....	11.3	3,514	46.6	1,164	78.6	1,571	26.0	779
August.....	11.1	3,452	45.7	1,143	77.1	1,543	25.5	766
September.....	9.1	2,830	37.5	937	63.2	1,265	21.0	628
October.....	8.0	2,488	33.0	824	55.6	1,112	18.4	552
November.....	7.2	2,239	29.7	742	50.1	1,001	16.6	496
December.....	7.2	2,239	29.7	742	50.1	1,001	16.6	496
Total.....	100.0	\$31,100	412.0	\$10,300	695.0	\$13,900	230.0	\$6,900

\$85. Applying this figure to the 1,330,000 cars expected to be in circulation results in total forecast industry sales of \$113.1 million.

4. Column 3 of Exhibit 16-3 shows the Tire Company's sales as percentages of total industry sales from 1957 to 1962. It is expected that in 1963 the Tire Company's share of the total market will be 27.5 percent. Applying this percentage to the total expected industry sales of \$113.1 million results in the 1963 sales budget for the Tire Company of \$31.1 million. The allocation of the budgeted sales among the three products (Exhibit 16-1) was made by the company's marketing experts.

The Tire Company's sales budget for 1963 also was prepared on a monthly basis after giving effect to seasonal tendencies, as shown in Exhibit 16-4.

## *Cost of sales and factory budgets*

### **Budgeted cost of sales and gross profit**

The standard cost of budgeted sales is derived by multiplying the forecast unit sales by the standard product costs. The difference between budgeted sales and standard cost of sales represents the standard gross profit. This is adjusted for anticipated variances from standard costs, which fall into the following three categories:

1. Over- or underabsorption of fixed costs. If the overhead absorption rate used for product costing is based on normal capacity, it is necessary to show the dollar effect of expected under- or overutilization of capacity.

2. Price variances. Frequently, a lag exists in the adjustment of standard costs for expected increases or decreases in raw materials prices or labor rates. To the extent possible, the profit plan should anticipate such variances.

3. Efficiency variances. Although factory standards may have been set at an attainable level of efficiency, it may be necessary to provide for certain variations from these standards. The introduction of a new product may require a learning period before labor can attain the standard level of efficiency. In seasonal businesses, it may be necessary to anticipate excess labor costs during peak periods because of the need to hire inexperienced workers.

The standard gross profit also may have to be adjusted because of a difference between the method used for costing inventories internally and that used for external reporting. For example, while a corporation may use standard costs internally, it may use Lifo for tax and other external reporting.

### **The production schedule**

Budgeted production is equal to forecast sales plus planned ending inventory of finished goods minus beginning inventory of finished goods.



The amount of the planned ending inventory of finished goods is based on three considerations:

1. The budgeted closing inventory of finished goods is affected by the future sales potential of each product. Products that are expected to be replaced or that are facing sales declines will be deliberately curtailed, and those whose sales are ascending will be increased.

2. The size of inventories carried is limited by physical constraints such as the size of the stock room and the capacity of the plant.

3. The optimum size of inventories is equal to combined minimum ordering and processing costs and the cost of carrying inventories. This subject will be discussed at greater length in a later chapter.

### **The materials budget**

The budgeting of raw materials involves (1) determining the quantity and cost of raw materials needed to meet the production schedule, (2) establishing the desired raw materials inventory level, and (3) preparing a purchase budget.

The quantities of raw materials needed to meet the production schedule are determined by multiplying the number of units of raw materials per unit of finished product by the scheduled production. The budgeted cost of materials used is calculated by multiplying the total number of units required by their standard costs.

The amount of budgeted purchases is equal to the number of units of raw materials required to meet the production schedule plus the desired inventory balances at the end of the period minus the raw materials on hand at the beginning of the period. Budgeting purchases is highly desirable, since it permits the purchasing department to plan its activities in advance so as to avoid creating production bottlenecks and to take advantage of possible quantity discounts. Budgets also disclose the timing and amount of funds needed to finance these purchases.

### **The labor budget**

The budgeted cost of direct labor is determined by multiplying the standard labor cost of each product by the number of units scheduled to be produced. Generally, it also is desirable to prepare a manning table, i.e., budget of man-hours required. This serves as a guide to the personnel department in planning, recruiting, and training.

### **The variable factory-overhead budget**

Overhead controls are meaningful only when they provide a basis for comparing the actual expenses and the budgeted expenses adjusted to the actual level. The variable overhead budget, which has been discussed previously, contains overhead standards which are relevant regardless of the actual level of plant activity. The variable budget is used for both profit planning and performance evaluation.

**THE TIRE COMPANY**  
Standard Product Costs

Product	Production department	Raw materials cost				Direct-labor cost			Overhead cost		Cumulative unit cost
		Raw material item	Units required per unit of finished product	Standard unit price	Raw material cost per unit of finished product	Standard hr per unit	Average hourly rate	Labor cost per unit finished product	Department overhead rate per hr	Overhead cost per unit of finished product	
X	A	M <sub>1</sub>	4	\$ .60	\$2.40	.75	\$2.00	\$1.50	\$3	\$2.25	\$ 7.95
		M <sub>2</sub>	10	.11	1.10	.5	2.20	1.10	4	2.00	11.05
		M <sub>3</sub>	350	.002	.70	.7	2.00	1.40	2	1.40	15.65
		M <sub>4</sub>	18	.10	1.80			\$4.00			
Y	A	M <sub>1</sub>	3	.60	\$6.00	.6	2.00	\$1.20	\$3	\$1.80	\$ 6.50
		M <sub>2</sub>	10	.11	1.10	.5	2.20	1.10	4	2.00	9.60
		M <sub>3</sub>	300	.002	.60	.6	2.00	1.20	2	1.20	13.50
		M <sub>4</sub>	15	.10	1.50			\$3.50			
Z	A	M <sub>1</sub>	4	.60	\$5.00	1.2	2.00	\$2.40	\$3	\$3.60	\$10.40
		M <sub>2</sub>	10	.11	2.40	.5	2.20	1.10	4	2.00	13.50
		M <sub>3</sub>	450	.002	.90	.75	2.00	1.50	2	1.50	18.60
		M <sub>4</sub>	21	.10	2.10			\$5.00			

**Exhibit 16-6**

**THE TIRE COMPANY**

**Budgeted Gross Profit**

**For the Year Ended December 31, 1963**

	<b>Product X</b>		<b>Product Y</b>		<b>Product Z</b>		
	<i>Per unit</i>	<i>Amount, in thousands</i>	<i>Per unit</i>	<i>Amount, in thousands</i>	<i>Per unit</i>	<i>Amount, in thousands</i>	<i>Total, in thousands</i>
Sales [Exhibit 16-4]	\$25.00	\$10,300.0	\$20.00	\$13,900.0	\$30.00	\$6,900.0	\$31,100.0
Cost of sales	15.65	6,447.8	13.50	9,382.5	18.60	4,278.0	20,108.3
Standard gross profit	<u>\$ 9.35</u>	<u>\$ 3,852.2</u>	<u>\$ 6.50</u>	<u>\$ 4,517.5</u>	<u>\$11.40</u>	<u>\$2,622.0</u>	<u>\$10,991.7</u>
Adjustments to standard gross profit:							
Anticipated wage increase not provided for in standards						\$ 233.6	
Expected underabsorption of factory overhead						50.0	
Lifo inventory adjustment						100.0	
Budgeted gross profit							<u>383.6</u>
							<u>\$10,608.1</u>

### The Tire Company—cost of sales and factory budgets

For simplicity, it will be assumed that there are three producing departments in the Tire Company's factory and that only four raw materials are used. The standard cost of each of the products manufactured appears in Exhibit 16-5. These standards are constructed to reveal the cumulative unit costs at the end of each producing department. This facilitates accounting for interdepartmental transfers of work in process, costing spoilage, and costing inventories in process.

The standard cost of budgeted sales and the standard gross profit are shown in Exhibit 16-6. As indicated, adjustments have been provided for variances from standard and for inventory costing.

Exhibit 16-7 contains the production schedule for 1963. This may be altered during the year if the sales forecast or planned inventory levels are revised.

The calculation of the quantity and cost of raw materials is illustrated for item M<sub>1</sub> in Exhibit 16-8. These data, when combined with planned balances of raw materials, provide the basis for establishing the purchase requirements.

The budgeted direct-labor cost for the year 1963 is shown in Exhibit

#### Exhibit 16-7

**THE TIRE COMPANY**  
Monthly Production Schedule and Budgeted Inventories  
For the Year Ended December 31, 1963  
(In thousands of dollars)

Month	Product X		Product Y		Product Z	
	Production	Ending inventory	Production	Ending inventory	Production	Ending inventory
December, 1962.....	—0—	\$50.0	—0—	\$69.0	—0—	\$13.1
January, 1963.....	\$ 31.0	57.2	\$ 53.5	82.2	\$ 18.5	18.3
February.....	31.0	64.4	53.5	95.4	18.5	23.5
March.....	31.0	64.9	53.5	97.5	18.5	25.0
April.....	31.0	60.9	53.5	92.0	18.5	24.0
May.....	37.2	61.0	64.7	94.1	22.5	25.8
June.....	37.2	58.6	64.7	92.1	22.5	26.2
July.....	37.2	49.2	64.7	78.2	22.5	22.7
August.....	30.0	37.5	51.5	52.6	17.5	14.7
September.....	37.2	33.2	64.7	54.1	22.5	16.2
October.....	37.2	37.4	64.7	63.2	22.5	20.3
November.....	31.0	38.7	53.5	66.6	18.5	22.2
December.....	31.0	40.0	53.5	70.0	18.5	24.1
Total.....	\$402.0		\$696.0		\$241.0	

*Exhibit 16-8*

**THE TIRE COMPANY**  
**Budget of Raw Materials Used—Item M<sub>1</sub>**  
**For the Year Ended December 31, 1963**

	<i>Units of M<sub>1</sub> required for scheduled production</i>	
Product X:		
Units M <sub>1</sub> required per unit X.....	4	
Scheduled production.....	<u>402,000</u>	1,608,000
Product Y:		
Units M <sub>1</sub> required per unit Y.....	3	
Scheduled production.....	<u>696,000</u>	2,088,000
Product Z:		
Units M <sub>1</sub> required per unit Z.....	4	
Scheduled production.....	<u>241,000</u>	964,000
Total units M <sub>1</sub> required.....		<u>4,660,000</u>
Standard price per unit.....		<u>\$ .60</u>
Standard cost of M <sub>1</sub> required.....		<u><u>\$2,796,000</u></u>

16-9. The total budgeted hours for each department is useful from the standpoint of personnel planning.

The variable overhead budget for department A is shown in Exhibit 16-10. The budget level of this department, which is used for setting the overhead absorption rate for product-costing purposes, is 1,008,300 hours. At this level, the fixed overhead is expected to amount to \$1,109,100 and the variable overhead \$1,915,800 (i.e.,  $\$1.90 \times 1,008,300$ ), or a total of

*Exhibit 16-9*

**THE TIRE COMPANY**  
**Budgeted Direct Labor**  
**For the Year Ended December 31, 1963**

Product	Budgeted production	<i>Budgeted direct labor</i>					
		<i>Department A</i>		<i>Department B</i>		<i>Department C</i>	
		<i>Stand- ard hr per unit</i>	<i>Total, hr</i>	<i>Stand- ard hr per unit</i>	<i>Total, hr</i>	<i>Stand- ard hr per unit</i>	<i>Total, hr</i>
X	402,000	.75	301,500	.5	201,000	.7	281,400
Y	696,000	.6	417,600	.5	348,000	.6	417,600
Z	241,000	1.2	289,200	.5	120,500	.75	180,750
Total budgeted hours.....			<u>1,008,300</u>		<u>669,500</u>		<u>879,750</u>
Standard hourly rate.....			<u>\$2.00</u>		<u>\$2.20</u>		<u>\$2.00</u>
Budgeted direct labor.....			<u><u>\$2,016,600</u></u>		<u><u>\$1,472,900</u></u>		<u><u>\$1,759,500</u></u>



## Exhibit 16-10

**THE TIRE COMPANY**  
**Variable Factory-overhead Budget—Department A**  
**For the Year Ended December 31, 1963**

	<i>Fixed expense in thousands of dollars</i>	<i>Variable rate per hr of direct labor</i>
Direct departmental overhead:		
Supervision.....	\$ 36.0	-0-
Office.....	16.0	-0-
Material handlers.....	-0-	\$ .09
Quality inspectors.....	18.0	.07
Timekeepers.....	12.0	.07
Maintenance labor.....	43.0	.02
Repair labor.....	38.0	.25
Overtime premium.....	-0-	.08
Repair supplies.....	-0-	.36
Maintenance supplies.....	140.0	.10
Other supplies.....	115.0	.29
Power.....	13.0	.27
Depreciation.....	160.0	-0-
Miscellaneous.....	87.0	-0-
Total direct.....	<u>\$ 678.0</u>	<u>\$1.60</u>
Allocated departmental overhead:		
Building maintenance.....	70.0	-0-
Factory manager's office.....	28.3	-0-
Purchasing, receiving, storing.....	170.5	.10
Production planning.....	62.0	.04
Cost accounting.....	30.3	.05
Factory personnel.....	70.0	.11
Total allocated.....	<u>\$ 431.1</u>	<u>\$ .30</u>
Total department overhead.....	<u><u>\$1,109.1</u></u>	<u><u>\$1.90</u></u>

\$3,024,900. Thus, a rate of \$3 an hour was derived from \$3,024,900/1,008,300.

### *The selling expense budget*

Selling expenses include all costs related to the maintenance, promotion and distribution of finished products. They represent a major category of costs, frequently ranging from 20 to 30 percent of cost of sales. The principles underlying the establishment of a selling expense budget are no different from those of factory overhead, although greater difficulty

may be experienced in finding satisfactory bases for measuring the variability of certain of these expenses.

Selling expenses may be classified in several different ways, depending upon the organization structure, the nature of the selling activities, and the type of control desired. They are often divided into the following four categories: (1) main-office selling expenses, (2) district sales office selling expenses, (3) district warehouse expenses, and (4) advertising.

Each of these categories may be further subdivided into functional areas of responsibility. For example, main-office expenses may be segregated according to (1) sales management, i.e., development and administration of sales policies and selling activities, (2) market research, and (3) internal transportation. District warehousing may be subdivided into administration, receiving, storing, shipping, trucking, and billing.

### The Tire Company—selling expense budget

The variable expense budget for the Tire Company is presented in summary form in Exhibit 16-11. This is supported by detailed budgets for each function and for each sales district as illustrated for district warehousing in Exhibit 16-12. The Tire Company maintains a centrally located warehouse in each of its four sales districts. Upon completion, all finished goods are shipped in carload lots directly from the factory to the warehouses. It will be assumed, for the purpose of expense budgeting, that

#### Exhibit 16-11

### THE TIRE COMPANY

Summary—Variable Budget of Selling Expenses  
For the Year Ended December 31, 1963

	<i>Fixed expense, in thousands of dollars</i>	<i>Variable expense Base</i>	<i>Rate</i>
Main office:			
Sales management.....	\$ 77	Sales	\$ .0016
Market research.....	78	Sales	\$ .0017
Internal transportation....	40	M units produced	\$1,599 .10
District sales offices:			
Sales management.....	244	Sales	\$ .0038
Selling.....	120	Sales	\$ .0602
District warehousing:			
Administrative.....	240	Sales	\$ .0018
Receiving and storing....	219	M units received	\$52 .25
Shipping.....	141	M units shipped	\$689 .60
Trucking.....	307	Truck mile	\$ .087
Billing.....	80	M invoices	\$30
Advertising.....	387	-0-	-0-
Total fixed expense.....	\$1,933		

## Exhibit 16-12

**THE TIRE COMPANY**  
**Variable Budget of Selling Expenses—Warehousing**  
**For the Year Ended December 31, 1963**

		<i>Total all warehouses</i>	
	<i>Fixed expense, in thousands of dollars</i>	<i>Variable expense Base</i>	<i>Rate</i>
<b>Administrative:</b>			
Executive.....	\$ 53	Sales	-0-
Office salaries.....	87	Sales	\$ .0010
Office supplies.....	42	Sales	.0008
Space costs and utilities.....	58	Sales	-0-
Total.....	<u>\$240</u>	Sales	<u>\$ .0018</u>
<b>Receiving and storing:</b>			
Supervision.....	\$ 34	M units received	-0-
Receiving and storing salaries.....	94	M units received	\$30.15
Supplies.....	61	M units received	22.10
Depreciation—materials handling equipment.....	8	M units received	-0-
Miscellaneous.....	22	M units received	-0-
Total.....	<u>\$219</u>	M units received	<u>\$52.25</u>
<b>Shipping:</b>			
Supervision.....	\$ 32	M units shipped	-0-
Shipping salaries.....	66	M units shipped	\$ 33.80
Transportation charges.....	-0-	M units shipped	655.80
Miscellaneous.....	43	M units shipped	-0-
Total.....	<u>\$141</u>	M units shipped	<u>\$689.60</u>
<b>Trucking:</b>			
Supervision.....	\$ 36	Truck mile	-0-
Drivers' salaries.....	180	Truck mile	-0-
Truck repairs.....	-0-	Truck mile	\$ .020
Truck maintenance.....	-0-	Truck mile	.015
Truck supplies.....	-0-	Truck mile	.004
Truck depreciation.....	60	Truck mile	-0-
Gas and oil.....	-0-	Truck mile	.042
Tolls, licenses and fees.....	1	Truck mile	.006
Truck insurance.....	6	Truck mile	-0-
Miscellaneous.....	24	Truck mile	-0-
Total.....	<u>\$307</u>	Truck mile	<u>\$.087</u>
<b>Billing:</b>			
Supervision.....	\$ 24	M invoices	-0-
Billing salaries.....	44	M invoices	\$20
Supplies.....	-0-	M invoices	10
Miscellaneous.....	12	M invoices	-0-
Total.....	<u>\$ 80</u>	M invoices	<u>\$30</u>
Total fixed expense.....	<u><u>\$987</u></u>		

the size and weight of the three types of tires produced do not vary significantly.

### The advertising budget

Measuring the effectiveness of advertising is a difficult and largely unresolved problem. In a survey conducted among 150 manufacturing firms, the National Industrial Conference Board discovered that three-fifths of the participating firms reported dissatisfaction with their present methods for measuring the effectiveness of advertising. Among the remaining two-fifths, only a very small number considered their evaluation of advertising expenditures adequate.<sup>1</sup>

Efforts to measure advertising have been impeded by several rather imposing problems:

First, the effectiveness of advertising varies under different economic conditions and at different operating levels.

Second, a time lag exists between the incurrence of advertising and its effect.

Third, the impact of advertising on buying cannot easily be separated from other influences, such as other selling methods, availability of buying power, alternative spending possibilities, actions of competitors.

Fourth, advertising may cause mere shifts in the timing of purchases rather than create a new demand for the product.

The extent to which advertising effectiveness can be measured varies with different media. Direct-mail, newspaper, and magazine advertising which contain coupons or reply cards generally represent the most measurable of advertising media. Local advertising can be more readily measured than national advertising. One frequently used criterion is the estimated number of potential buyers reached. Advertisers attach considerable value to newspaper and magazine circulations and radio and television program ratings. However, advertisers can never be certain of the extent of sponsor identification by the audience.

In theory, the only correct way to establish the advertising budget is to relate it to incremental income derived from advertising expenditures. Unfortunately, the results of advertising generally cannot be evaluated with sufficient accuracy for this method to constitute a practical procedure. How then do business executives decide on the amount to spend on advertising? Unquestionably, intuitive judgment is an important factor. Criteria such as the following also play an important role:

1. Ratio to sales. One of the commonest methods for determining the advertising budget is to base it on an established percentage of sales. Despite common usage, this method is not sound. The existence of advertising elasticity indicates that the effectiveness of advertising varies with business cycles, at different sales volumes, for different products, in different regions, and with different intensities of competition.

<sup>1</sup> Sorrell M. Mathers and G. Clark Thompson, "The Art and Science of Advertising Measurement," *The Conference Board Business Record*, February, 1960, p. 22.

*Exhibit 16-13*

**THE TIRE COMPANY**  
**Variable Budget of Selling Expenses—Advertising**  
**For the Year Ended December 31, 1963**  
(In thousands of dollars)

	<i>Fixed expense</i>	<i>Variable expense</i>
Executive.....	\$ 26	-0-
Drafting and art work.....	34	-0-
Clerical.....	22	-0-
Advertising supplies.....	40	-0-
Office supplies.....	6	-0-
Agency fees.....	46	-0-
Insertions and program time.....	208	-0-
Miscellaneous.....	5	-0-
<b>Total.....</b>	<b>\$387</b>	<b>-0-</b>

2. Funds available. According to this method, the amount that will be spent on advertising depends on the funds expected to be available. This is so far removed from the theoretically correct incremental approach as to be obviously illogical.

3. Competition. One of the most important factors in planning advertising expenditures is the extent of competitors' advertising. In practice, specific information on competitors' advertising expenditures may be difficult to obtain. It also cannot be assumed that competitors are receiving optimum results or that selling problems are identical even among companies in the same industries.

### **The Tire Company—advertising budget**

The advertising budget for 1963 for the Tire Company is presented in Exhibit 16-13. It will be observed that, once approved, the budget consists entirely of fixed expenses.

## *The administrative budget*

The administrative budget includes the top-management function as well as certain service activities such as legal, finance, and accounting. The functions included in the administrative budget vary with the size of companies and their organization structures. Large companies normally maintain their own legal, internal audit, tax, and insurance departments. Small companies are more apt to rely on outside experts. In some companies the legal and treasury activities are combined. In others they will operate separately. The credit department may be included in the



accounting, treasury, or sales function. The tax service may be found in either the accounting or legal departments.

A large portion of administrative costs tend to be fixed or not clearly related to sales. Office personnel are less apt to be discharged when volume declines than are factory workers. There is apt to be excess office manpower at lower operating levels and heavier work loads at higher levels.

The most troublesome aspect of administrative budgeting is the measurement of output. Several units of measurement may be required for even a single center of responsibility. For example, we may seek in vain for a single base for measuring the activity of the general accounting function. Measurement is facilitated, however, if the function is divided into homogeneous activities, as shown below:

<i>Activity</i>	<i>Unit of measurement</i>
Accounts payable	Bills handled
Cash receipts	Checks received
Accounts receivable	Invoices posted
Secretarial	Letters typed

### The Tire Company—administrative budget

A summary of the administrative expense budget of the Tire Company is presented in Exhibit 16-14. The building maintenance function is included in the administrative budget, since the manager of this function reports directly to top management. Building maintenance expenses are first charged to this department, and then a portion is allocated to the factory to permit its inclusion in overhead absorption rates. The summary administrative budget is supported by detailed budgets for each of the functions, as is shown for the accounting function in Exhibit 16-15.

#### Exhibit 16-14

### THE TIRE COMPANY

#### Summary—Variable Budget of Administrative Expenses For the Year Ended December 31, 1963

	<i>Fixed expense, in thousands of dollars</i>		<i>Variable expense Base      Rate</i>
Top management.....	\$370	Sales	\$ .0013
Treasury department.....	157	Sales	.0004
Legal department.....	69	Sales	—0—
Accounting department.....	150	Sales	.0004
Building maintenance.....	236	Sales	—0—
Total.....	\$982	Sales	\$ .0021

## Exhibit 16-15

**THE TIRE COMPANY**  
**Variable Budget of Administrative Expenses—Accounting**  
**For the Year Ended December 31, 1963**

	<i>Fixed expense, in thousands of dollars</i>	<i>Variable expense</i>	
		<i>Base</i>	<i>Rate</i>
<b>Controller's office:</b>			
Salaries—executive.....	\$ 21	Sales	-0-
Salaries—staff assistants.....	12	Sales	-0-
Salaries—secretarial.....	8	Sales	-0-
Audit fees.....	9	Sales	-0-
Traveling.....	2	Sales	-0-
Miscellaneous.....	3	Sales	-0-
<b>Total</b> .....	<b>\$ 55</b>	Sales	-0-
<b>General accounting:</b>			
Salaries—supervisory.....	\$ 11	Sales	-0-
Salaries—clerical.....	17	Sales	\$.0002
Salaries—machine operators.....	14	Sales	.0002
Salaries—secretarial.....	7	Sales	-0-
Depreciation—office equipment.....	3	Sales	-0-
Supplies.....	4	Sales	-0-
Miscellaneous.....	2	Sales	-0-
<b>Total</b> .....	<b>\$ 58</b>	Sales	<b>\$.0004</b>
<b>Payroll accounting (nonfactory):</b>			
Salaries—supervisory.....	\$ 7	Sales	-0-
Salaries—clerical.....	9	Sales	-0-
Depreciation—payroll equipment.....	1	Sales	-0-
Supplies.....	2	Sales	-0-
Miscellaneous.....	1	Sales	-0-
<b>Total</b> .....	<b>\$ 20</b>	Sales	-0-
<b>Property accounting:</b>			
Salaries—supervisory.....	\$ 7	Sales	-0-
Salaries—clerical.....	8	Sales	-0-
Miscellaneous.....	2	Sales	-0-
<b>Total</b> .....	<b>\$ 17</b>	Sales	-0-
<b>Total expense</b> .....	<b><u>\$150</u></b>	Sales	<b><u>\$.0004</u></b>

### The research budget

Industrial research includes the development of new products, the betterment of existing products, improvement of processes, and pure research. The type and extent of the research engaged in is related to the nature of the industry. An oil company is compelled to maintain labora-

tories to test the results of its exploratory drillings. The growth of a drug firm largely depends on the introduction of new products. The rapidly changing technology of the electronics industry makes research imperative. The almost endless variety of potential products in petrochemicals requires substantial research outlays.

Except over relatively long periods of time, the profitability of research cannot be accurately measured. As a consequence, business executives have been compelled to rely upon inadequate guides and intuitive judgment. Where specific projects are involved, a somewhat greater opportunity for profit prediction exists. However, the bulk of industrial research expenditures do not presently appear to be based on specific projects. Robert N. Anthony reveals that only 11 percent of the respondents in a study he conducted indicated that their research appropriations were based on specific projects.<sup>2</sup>

The difficulties encountered in predicting the profitability of research expenditures are similar in many respects to that of advertising. The rules of thumb employed bear a distinct resemblance. Thus, in practice research expenditures are apt to be based on an established percentage of sales, matching the actions of competitors or the estimated amount expected to be available during the budget period. Yet, the only economically sound manner in which to judge the desirability of research is in terms of incremental profit. This is possible only in isolated instances where the purpose of the research has been clearly defined, where the costs can be reasonably estimated in advance, where the flow of revenue is predictable, and, above all, where the possibility of success can be foreseen.

There is a continuity to research which defies even retrospective measurements of profit. Intuitive managerial judgment, rather than reliance on quantitative data, represents the basis for the major portion of research expenditures.

While, in general, quantitative measurement of the effectiveness of research is itself ineffectual, this does not imply that research costs are uncontrollable. On the contrary, the very inability to measure the profitability of research makes the control of these expenditures more imperative. The following procedure is suggestive of the possibilities for controlling research costs.

1. A system should be established for the initiation, selection, and approval of research expenditures. Employees should be encouraged, through incentives or other methods, to submit proposals for new and improved products and processes. A committee consisting of operating and scientific personnel should be appointed to evaluate all proposals and to prepare a recommended list for top-management approval.

2. To the extent possible, research appropriations should be based on

<sup>2</sup> Robert N. Anthony, *Management Controls in Industrial Research Organizations* (Cambridge, Mass.: Harvard University Press, 1952).

specific projects. Each project should contain a complete description of the research activity, the estimated length of the commitment, the department required to perform the research, the nature and amount of the budgeted project costs, and, where possible, a prediction as to profitability.

3. Progress reports should be prepared at stated intervals which indicate the results achieved and the likelihood of future success.

4. Periodic comparisons should be made between the budgeted and actual research costs, by project and by research cost center.

### The Tire Company—research budget

The research budget for the Tire Company is presented in Exhibit 16-16 (by project and cost center).

#### Exhibit 16-16

### THE TIRE COMPANY

Variable Budget of Research Expenses  
For the Year Ended December 31, 1963  
(In thousands of dollars)

#### By project:

Project number	Spent in prior years	1963 budget	Total estimated expenditures as of Dec. 31, 1963	Estimated requirements after Dec. 31, 1963, per annum	Expected termination date
100	\$600	\$100	\$ 700	\$100	Standing
102	80	40	120	-0-	1963
109	110	60	170	240	1965
110	70	65	135	-0-	1963
115	50	60	110	40	1964
Total.....	\$910	\$325	\$1,235		

#### By research center:

Expense	Center 1	Center 2	Center 3
Executive.....	\$ 20	\$21	\$ 23
Scientific personnel.....	50	35	45
Technical assistants.....	15	10	15
Consultants.....	2	4	4
Secretarial and clerical.....	4	8	8
Professional fees.....	3	3	4
Travel.....	-0-	-0-	6
Supplies.....	12	6	16
Depreciation—equipment.....	1	1	2
Miscellaneous.....	3	2	2
Total.....	\$110	\$90	\$125

*Exhibit 16-17*

**THE TIRE COMPANY**  
**Finalized Profit Plan**  
**Year Ended December 31, 1963**

Sales.....		\$31,100.0
Cost of sales—at standard.....		20,108.3
Standard gross profit.....		<u>\$10,991.7</u>
Less: Adjustments		
Anticipated wage increase not provided for in standards.....	\$ 233.6	
Expected under absorption of factory overhead.....	50.0	
Lifo inventory adjustment.....	<u>100.0</u>	383.6
Budgeted gross profit.....		<u>\$10,608.1</u>
Less: Selling, administrative and research		
Selling expenses:		
Main office.....	\$2,438.9	
District sales offices.....	2,354.4	
Warehousing.....	2,118.0	
Advertising.....	<u>387.0</u>	
Total selling.....	\$7,298.3	
Administrative expenses:		
Top management.....	\$ 410.4	
Treasury.....	169.4	
Legal.....	69.0	
Accounting.....	162.4	
Building maintenance.....	<u>236.0</u>	
Total administrative.....	\$1,047.2	
Research expenses.....	<u>\$ 325.0</u>	8,670.5
Budgeted pretax profit.....		<u>\$ 1,937.6</u>
Budgeted return on sales.....		6.2%
Budgeted return on capital (average capital investment \$10,000,000).....		19.4%

**The Tire Company—finalized budget**

The final budget for the Tire Company is presented in Exhibit 16-17 in summary form.

*Profit improvement plan*

The profit improvement plan is a studied effort to better the performance of divisions that are not realizing their profit potential. It is concerned with the elimination of profit leakages that prevent a division from maximizing its return on investment. Profit improvement is accomplished by (1) augmenting sales, (2) achieving a better product mix, (3) reducing costs, and (4) minimizing capital investment.



An effective profit improvement plan should include the following features:

1. The plan should consist of specific proposals. The expected effect on profits of each proposal should be indicated clearly and the individual responsible for its attainment designated.
2. A minimum return on investment target should be established for each division and standards of performance for each plant and function within a plant.
3. The profit improvement plan should extend sufficiently into the future to permit realization of the specified improvements.
4. The function of profit improvement should be provided for in the organization structure. Profit improvement committees should be established at different company levels for approving proposals and for following up on their realization.
5. A reporting procedure should exist which discloses the extent to which the profit improvement plan is being attained.

Westinghouse Electric Corporation has pioneered in the development of profit improvement plans. Figure 16-2 is an interesting example of how this company compares the actual return on investment of its different product lines with the company's established goal of 20 percent return on investment. This approach not only focuses attention on substandard

Total asset turnover  
(dollar sales per \$1.00 assets)

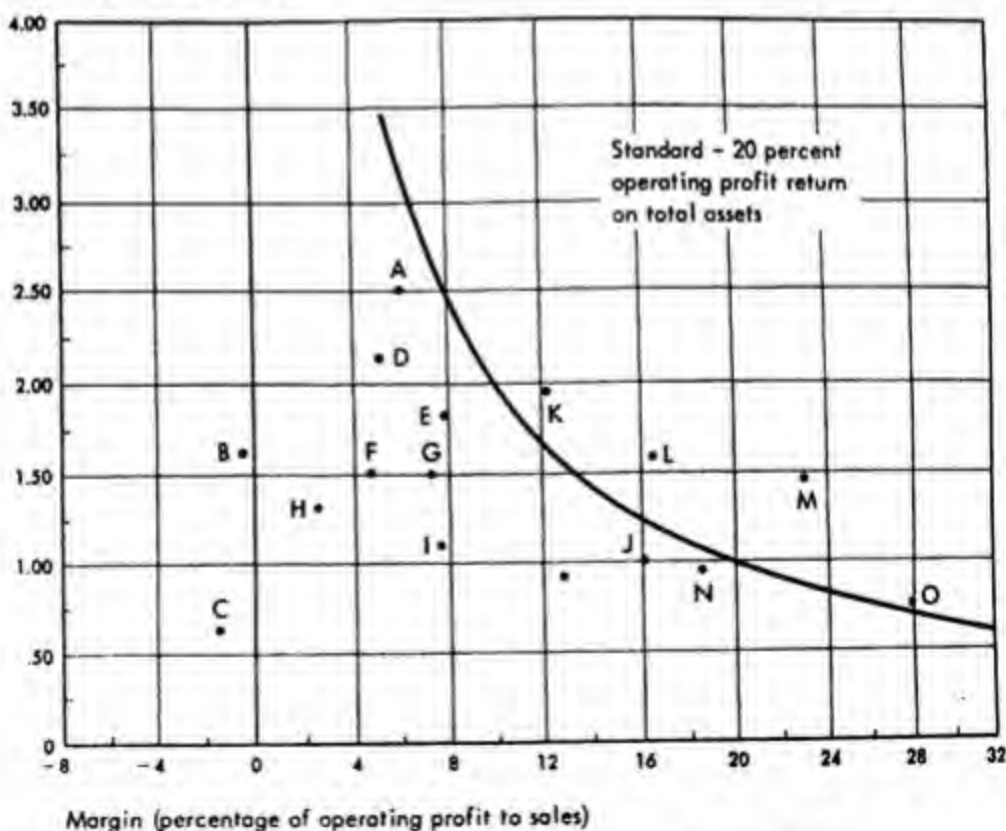


Fig. 16-2 Profit margins and asset turnovers by product lines.

# Exhibit 16-18

## Profit Improvement Plan

	Present		Change by volume	Change by cost reduction	Effect of planned programs		
	Amount	Percent*			Asset curtailment	Future Amount	Future Percent*
<b>Profits:</b>							
Sales billed.....	\$1,000,000	100.0%	+\$200,000	-0-	-0-	\$1,200,000	100.0%
Manufacturing cost.....	770,000	77.0	+ 140,000	-\$88,000	-0-	822,000	68.5
Distribution expense.....	50,000	5.0	+ 4,000	-0-	-0-	54,000	4.5
Engineering expense.....	50,000	5.0	+ 6,000	-0-	-0-	56,000	4.7
Administrative expense.....	30,000	3.0	-0-	- 2,000	-0-	28,000	2.3
Profit (before taxes).....	100,000	10.0	+ 50,000	+ 90,000	-0-	240,000	20.0
<b>Assets:</b>							
Inventory.....	\$ 500,000				-\$100,000	\$ 400,000	
Other working capital.....	200,000		+\$ 20,000	-0-	-0-	220,000	
Fixed assets.....	300,000		-0-	+\$80,000	-0-	380,000	
Total.....	\$1,000,000		+\$ 20,000	+\$80,000	-\$100,000	\$1,000,000	
<b>Return on assets:</b>							
Profit margin.....		10.0%					20.0%
Multiplied by: Asset turnover ratio.....		1.0					1.2
Return on assets.....		10.0%					24.0%

\* Percent of sales billed.

SOURCE: Russell B. Read, "Return on Investment: A Guide to Management Decisions, *NACA Bulletin*, June, 1954.

areas but also facilitates comparisons between divisions and product lines. Russell B. Read, the Westinghouse treasurer, cites the following examples of benefits derived from such comparisons:<sup>2</sup>

This process can be exemplified by reference to two of the hypothetical divisions (or product lines) of an imaginary company illustrated [Fig. 16-2]. For one example, a look at Division A will be revealing. This division has a substandard asset return performance. This is measured by the linear distance from the dot plotted for Division A and the curve representing the company standard, which in this case is a 20% operating profit return on sales. In considering how it can work toward a more satisfactory return, the division manager sees that, in comparison with the other divisions, his asset turnover performance is the best but his margin, at only 6%, is below the average. He is particularly impressed by the fact that Division K, with operating and product characteristics very similar to his own, produces a return in excess of the company standard. He sees also that this is achieved by twice as favorable a margin performance, in spite of a less favorable rate of asset turnover. He decides, therefore, that, in his long-range planning, he will approach the problem of margin by attacking manufacturing costs and operating expenses. He realizes his advantage in a better rate of asset turnover. He decides to set his margin goal to equal Division K, i.e., 12%, at the same time sustaining his turnover ratio which, if achieved, would result in a better asset return ratio than the other division's current performance.

A summarized profit improvement plan appears in Exhibit 16-18. Each line item would be supported by specific proposals.

### *Analysis of gross profit variation*

A condensed income statement for the Tire Company, comparing the actual results for the year ended December 31, 1963, with the profit plan, appears in Exhibit 16-19. It will be noted that there is an unfavorable variation in the standard gross profit of \$151,700. When the several causes of this variation can be isolated, management is provided with useful control information. In the remainder of this chapter, the methods for calculating the separate elements of this variation will be demonstrated.

The variation in standard gross profit is primarily due to a volume variance, price variance, and product mix variance. They may be defined as follows:

**Volume variance:** The effect on gross profit of selling more or less units than budgeted, assuming no variation from budget price or product mix.

**Price variance:** The effect on gross profit of the difference between actual and budgeted prices for the actual quantity of products sold.

<sup>2</sup> Russell B. Read, "Return on Investment: A Guide to Management Decisions," *NACA Bulletin*, vol. 35, no. 10, June, 1954.

*Exhibit 16-19*

**THE TIRE COMPANY**  
**Comparison of Actual and Budgeted Income**  
**Year Ended December 31, 1963**  
(In thousands of dollars)

	<i>Actual</i>	<i>Budget</i>	<i>Variation</i>
Sales.....	\$30,000	\$31,100.0	\$(1,100.0)
Cost of sales—at standard.....	19,160	20,108.3	948.3
Standard gross profit.....	\$10,840	\$10,991.7	\$ (151.7)
Less: Variations from standard and inventory adjustment.....	400	383.6	(16.4)
Actual and budgeted gross profit.....	\$10,440	\$10,608.1	\$ (168.1)
Less: Selling, administrative, and research expenses			
Selling.....	\$ 6,900	\$ 7,298.3	\$ 398.3
Administrative.....	1,100	1,047.2	(52.8)
Research.....	330	325.0	(5.0)
Total.....	\$ 8,330	\$ 8,670.5	\$ 340.5
Pretax profit.....	\$ 2,110	\$ 1,937.6	\$ 172.4
Return on sales.....	7.0%	6.2%	.8%
Return on capital.....	19.5%	19.4%	.1%

**Product mix variance:** The effect on gross profit of the difference between the actual mix of products sold, i.e., proportion of each product in the total, and the budgeted mix.

The volume variance may be separated further into an industry market variance and share of the market variance, as shown below. This distinction is important, since the former is beyond the control of the sales function while the latter normally is viewed as controllable.

**Industry market variance:** The effect on gross profit of a difference between the actual and estimated total industry market, assuming the company's share of the market, prices, and product mix conform to the budget.

**Share of the market variance:** The effect on gross profit of a difference between the company's share of the actual industry market and the budget, assuming no variation in budgeted prices and product mix.

### Calculation of gross profit variances—the Tire Company

The calculation of the gross profit variances for the Tire Company for the year ended December 31, 1963, follows. The supporting details are contained in Exhibit 16-20, unless otherwise indicated.

## Exhibit 16-20

**THE TIRE COMPANY**  
**Data Supporting Computation of Gross Profit Variances**  
**Year Ended December 31, 1963**  
 (Units and amounts in thousands)

Product	Budget						
	Sales			Standard costs		Gross profit	
	(1) Units	(2) Average unit price	(3) Amount	(4) Average per unit	(5) Amount	(6) Average per unit	(7) Amount
X	412	\$25.00	\$10,300	\$15.65	\$ 6,447.8	\$ 9.35	\$ 3,852.2
Y	695	20.00	13,900	13.50	9,382.5	6.50	4,517.5
Z	230	30.00	6,900	18.60	4,278.0	11.40	2,622.0
Percent of sales	1,337	\$23.261	\$31,100 100.0%	\$15.04	\$20,108.3 64.66%	\$ 8.221	\$10,991.7 35.34%
	Actual						
	Sales			Standard costs		Gross profit	
	(8) Units	(9) Average unit price	(10) Amount	(11) Average per unit	(12) Amount	(13) Average per unit	(14) Amount
X	400	\$25.00	\$10,000	\$15.65	\$ 6,260	\$ 9.35	\$ 3,740
Y	680	20.00	13,600	13.50	9,180	6.50	4,420
Z	200	32.00	6,400	18.60	3,720	13.40	2,680
	1,280	\$23.438	\$30,000	\$14.969	\$19,160	\$ 8.469	\$10,840
	Actual Sales at Budget Prices						
	(15) Actual units sold	(16) Average budget unit price	(17) Actual amount of sales at budget prices	Standard cost		(20) Gross profit of actual sales at budget prices and standard costs	
				(18) Average per unit	(19) Amount		
X	400	\$25.00	\$10,000	\$15.65	\$ 6,260	\$ 3,740	
Y	680	20.00	13,600	13.50	9,180	4,420	
Z	200	30.00	6,000	18.60	3,720	2,280	
	1,280	\$23.125	\$29,600	\$14.969	\$19,160	\$10,440	



**Volume Variance:**

[(Budgeted unit sales) (weighted-average budgeted gross profit per unit)] - [(actual unit sales) (weighted-average budgeted gross profit per unit)]

$$\begin{array}{rcl} (1,337,000 \text{ units})(\$8.221) & = & \$10,991.7 \text{ thousand} \\ \text{col. 1} & \text{col. 6} & \\ (1,280,000 \text{ units})(\$8.221) & = & 10,522.9 \text{ thousand} \\ \text{col. 8} & \text{col. 6} & \underline{\$ (468.8 \text{ thousand})} \end{array}$$

Or

**Industry Market Variance:**

[(Expected industry sales) (budgeted share of market) (budgeted gross profit percent of sales)] - [(actual industry sales) (budgeted share of market) (budgeted gross profit percent of sales)]

$$\begin{array}{rcl} (\$113.1 \text{ million}) (.275) (.3534) & = & \$10,991.7 \text{ thousand} \\ \text{Exh. 16-3} & \text{Exh. 16-3 col. 7} & \\ (\$100.0 \text{ million}) (.275) (.3534) & = & 9,718.5 \text{ thousand} \\ * & \text{Exh. 16-3 col. 7} & \underline{\$ (1,273.2 \text{ thousand})} \end{array}$$

And

**Share of Market Variance:**

[(Actual industry sales) (budgeted share of market) (budgeted gross profit percent of sales)] - [(actual units sold) (weighted-average budgeted gross profit per unit)]

$$\begin{array}{rcl} (\$100.0 \text{ million}) (.275) (.3534) & = & \$ 9,718.5 \text{ thousand} \\ * & \text{Exh. 16-3 col. 7} & \\ (1,280,000)(\$8.221) & = & 10,522.9 \text{ thousand} \\ \text{col. 8} & \text{col. 6} & \underline{\$ 804.4 \text{ thousand}} \end{array}$$

Total industry market and share of market variances \$ (468.8 thousand)

**Price Variance:**

[(Actual units sold) (budgeted prices)] - [(actual units sold) (actual prices)]

$$\begin{array}{rcl} \$ 29.6 \text{ million} & & \\ \text{col. 17} & & \\ 30.0 \text{ million} & & \\ \text{col. 10} & & \\ \hline \$ .4 \text{ million} \end{array}$$

**Product Mix Variance:**

[(Actual units sold) (weighted-average budgeted gross profit per unit)] - (gross profit of actual sales at budgeted prices and standard costs)

$$\begin{array}{rcl} (1,280,000)(\$8.221) & = & \$10,522.9 \text{ thousand} \\ \text{col. 8} & \text{col. 6} & \\ & & 10,440.0 \text{ thousand} \\ & & \text{col. 20} \\ & & \underline{\$ (82.9 \text{ thousand})} \end{array}$$

\* It will be assumed that the actual industry market during 1963 amounted to \$100 million.

*Exhibit 16-21*

**THE TIRE COMPANY**  
**Recapitulation of Variation in Standard Gross Profit**  
**for the Year Ended December 31, 1963**

Actual gross profit—at standard costs.....	\$10,840,000
Budgeted gross profit.....	10,991,700
Unfavorable variation in standard gross profit.....	<u>\$ (151,700)</u>
Due to:	
Unfavorable industry market variance.....	\$(1,273,200)
Favorable share of market variance.....	804,400
Favorable price variance.....	400,000
Unfavorable mix variance.....	(82,900)
Total.....	<u>\$ (151,700)</u>

A recapitulation of the variation in standard gross profit for the Tire Company is presented in Exhibit 16-21.

### *Problems and cases*

- 16-1 *Interrelationship of plans.* What is the interrelationship of the profit plan, cash-flow projection and capital-investment budget?
- 16-2 *Performance standards, profit plan, and profit-improvement plan.* Distinguish among performance standards, the profit plan, and the profit-improvement plan.
- 16-3 *Control versus planning aspects of profit plan.* "One of our difficulties in budgeting is that, if we revise the profit plan frequently, its effectiveness as a control instrument diminishes. On the other hand, if we fail to make revisions, it does not provide management with an effective guide to the future." Comment.
- 16-4 *Sales forecasting.* "Budgeting is fine in theory, but it is dependent on sales forecasting, and how can we predict sales with any degree of certainty?" Comment.
- 16-5 *Advertising budget.* "We budget our advertising expenditures at 1 percent of sales. If there is a better way, I wish someone would tell us about it." Discuss.
- 16-6 *Industry market variance.* What purpose is served by calculating the industry market variance?
- 16-7 *Product-mix variance.* What is the product mix, and why should the product-mix variance be calculated?
- 16-8 *The effect of variances on contribution margin.* If a company has a direct costing system, would it be desirable to show the effect of the industry market, share of market, price, and mix variances on the contribution margin?

**16-9** *Preparation of profit plan.* Moyer and Moyer, Inc., manufactures a product that sells at \$1 per unit. In December, 1962, a budget covering operations for the first 6 months of 1963 is prepared. During January and February, sales and costs are in accordance with the budgeted figures.

March costs are found to increase substantially. On March 1, 1963, direct-labor costs increase by 15 percent; direct-materials costs, by 10 percent; fixed indirect labor (superintendent and foremen), by 10 percent; sales salaries, from \$500 to \$530 per day; administrative salaries, from \$600 to \$635 per day; and miscellaneous factory supplies and expenses, by 10 percent.

The management expects that the same number of units can be sold even though the selling price is increased by 10 cents per unit effective May 1, 1963.

The accountant is supplied with the following information taken from the original budget and is requested to prepare a revised budget covering the months of April, May, and June, 1963.

	<i>Sales, units</i>	<i>Production, units</i>	<i>Direct materials used</i>
Jan.....	265,000	260,000	\$58,920
Feb.....	260,000	280,000	64,060
Mar.....	268,000	275,000	61,482
Apr.....	286,000	270,000	62,710
May.....	260,000	240,000	55,843
June.....	292,000	285,000	75,198

Direct labor 18 cents per unit

Factory superintendent and assistant \$24,000 per annum

Factory foremen \$150 per day

Indirect factory labor 60% of direct labor

Municipal taxes and insurance \$55,200 per annum

Light, heat, and power \$90,000 per annum

Miscellaneous factory supplies and expenses \$300 per day

Depreciation \$8,600 per month

Fixed selling expenses \$650 per day

Variable selling expenses 6% of sales

Fixed administrative expenses \$750 per day

Variable administrative expenses 5% of sales

On January 1, 1963, there were 546,000 units of finished product on hand, valued at 65 cents each. Inventory costs are maintained on an Fifo basis, and the book value of the inventory as of January 31, 1963, was \$349,050. Work in process is to be ignored.

Manufacturing operations are conducted on a 5-day basis, 8 hours a day. Working days per month are January, 22; February, 20; March, 22; April, 21; May, 23; June, 22.

*Required:* A statement of operations (actual operations for January, February, and March, and budgeted operations for April, May, and June), supported by

an exhibit of Finished Goods Inventory calculations. (Use amounts to nearest dollars, omitting cents.)

(CCA adapted)

- 16-10** *Preparation of profit plan.* A manufacturer wishes to enter the hosiery knitting business but lacks sufficient capital. Hoping to obtain the necessary additional funds from temporary bank loans by indicating substantial profits, he has requested you to prepare a profit forecast by quarters, starting with the third quarter in 1962 and ending with the third quarter in 1963.

The statements are to be based upon the following estimates and assumptions:

1. Knitting machinery consisting of eight units costing \$170,000 will be ordered at once; delivery will require 1 month; and payment will be made as follows:

10% in cash with order.

10% in cash on delivery.

80% by notes dated August 1, 1962, maturing quarterly in equal amounts over two years, the first note falling due at the end of the first quarter of 1963. Interest at 6% will be paid quarterly on unpaid notes.

Auxiliary machinery will cost \$8,000; factory furniture, fixtures, etc., will cost \$2,000; both items will be purchased at once for cash.

2. Quarterly production of hosiery will be as follows:

3d quarter of 1962.....	-0-
4th quarter of 1962.....	4,000 dozen
1st quarter of 1963.....	6,000 dozen
Quarterly thereafter.....	24,000 dozen

3. Cost of production will be as follows:

Direct cost per dozen pairs of hosiery produced:

Thrown silk (purchased on terms of 90 days net)..... \$ 3

Direct labor, dyeing, etc..... 2

Factory overhead (exclusive of depreciation), by quarters:

Starting at once..... 2,000

4th quarter of 1962..... 4,000

1st quarter of 1963..... 9,000

Quarterly thereafter..... 15,000

Depreciation of fixed assets at a composite rate of 8% per annum will be provided, starting with the 4th quarter of 1962.

4. Selling expenses will be \$20,000 each quarter, starting at once.

5. General and administrative expenses by quarters will be as follows:

Starting at once..... \$3,000

4th quarter of 1962..... 5,000

Quarterly thereafter..... 6,000

6. Hosiery manufactured will be sold at the following prices:

80% firsts @ \$12 per dozen

20% seconds @ \$2 per dozen

with every four dozen firsts, one dozen seconds will be sold.

7. Inventories of thrown silk will be one-half of the consumption in the succeeding quarter.
8. Inventories of finished hosiery (it will be assumed that hosiery in process will be finished at the ends of quarters) will be as follows:

End of 3d quarter of 1962.....	-0-
End of 4th quarter of 1962.....	1,000 dozen
End of 1st quarter of 1963.....	1,000 dozen
End of each quarter thereafter.....	4,000 dozen

9. Inventory valuation of finished hosiery will be based upon cost at maximum production.
10. Each month's sales are to be equal to one-third of the quarter's sales. Do not provide for bad debts or income taxes.

*Required:* Set up profit forecasts and inventories for each quarter.

(AICPA adapted)

**16-11** *Preparation of profit plan.* The Bigbee Company manufactures a single product. The basic characteristics of the company's operations and accounting are as follows:

1. Productions is scheduled to maintain Finished Goods Inventory at a constant ratio (10 percent) to current sales.
2. Production is spaced evenly during each period.
3. Finished Goods Inventory at the end of the period is valued at the average cost of manufacture for the period.
4. Inventories of work in process and raw materials are small and may be ignored.

Production and sales data and the manufacturing cost of sales for the two preceding periods are as follows:

Units	Period	
	1	2
Beginning inventory.....	1,000	2,000
Production.....	21,000	31,000
	<u>22,000</u>	<u>33,000</u>
Sales.....	20,000	30,000
Ending inventory.....	<u>2,000</u>	<u>3,000</u>

Sales and costs	Period 1		Period 2	
	Amount	Per unit	Amount	Per unit
Sales.....	\$361,520		\$552,000	
Cost of sales:				
Direct materials.....	\$ 44,078	\$2.10	\$ 68,508	\$2.21
Direct labor.....	80,220	3.82	130,200	4.20
Factory overhead.....	49,713	2.37	62,213	2.01
Inventory variation.....	(7,510)		(8,680)	
Total.....	<u>\$166,501</u>		<u>\$252,241</u>	
Gross profit.....	<u>\$195,019</u>		<u>\$299,759</u>	



Other pertinent data are as follows:

1. The product is made by mixing materials A and B. The relative quantity of each of the two materials entering production and in finished units can be varied, but it was kept constant during periods 1 and 2. In period 3, the quantity of raw material A used in a unit of product will be decreased 8 percent, and the quantity of raw material B used in a unit of product will be increased 12 percent. The price of material A is expected to continue the trend of the past two periods and the price of material B is expected to increase 5 percent in period 3. The cost of each raw material used in production has been as follows:

Material	Period 1		Period 2	
	Amount	%	Amount	%
A	\$23,141	52.5	\$37,542	54.8
B	20,937	47.5	30,966	45.2
Total	<u>\$44,078</u>	<u>100.0</u>	<u>\$68,508</u>	<u>100.0</u>

2. Direct-labor man-hours per unit have been approximately constant during periods 1 and 2 and are expected to remain at the same figure in period 3. Effective at the middle of each of periods 1 and 2, wage increases of 10 percent per man-hour have been granted. A similar increase is expected at the middle of period 3.
3. The amount of fixed factory overhead was \$23,463 during periods 1 and 2 and is expected to continue at the same amount during period 3. The variable portion of factory overhead is expected to remain at the same amount per unit of production as in periods 1 and 2.
4. Sales in period 3 are expected to be 25,000 units @ \$19 per unit.

Prepare a projected statement of sales, manufacturing cost of sales, and gross profit for period 3, based on the preceding data. Support this statement with exhibits of your computations of (1) production data for period 3; (2) materials costs; (3) direct-labor costs; (4) factory overhead, showing the fixed and variable elements; and (5) inventory variation (increase or decrease).

*Note:* Round off all total costs to the nearest dollar and all unit costs to the nearest cent.

(AICPA)

- 16-12 *Preparation of profit plan.* The Fortissimo Oil Company operates a refinery in Genoa and sells its products entirely within the confines of Italy. Gasoline and motor oil are distributed through an affiliated company, the Blue Star Oil Company.

Finished stocks on hand on December 31, 1962, were as follows:

	Tons on hand Dec. 31, 1962	Cost per ton	Total inventory cost
Gasoline	600,000	\$35-	\$21,000,000
Diesel oil	100,000	24-	2,400,000
Fuel oil	300,000	20-	6,000,000
Derivatives	40,000	25-	1,000,000
Total	1,040,000		\$30,400,000

During 1962, refinery sales were as follows:

Gasoline.....	2,160,000 tons
Diesel oil.....	330,000 tons
Fuel oil.....	890,000 tons
Derivatives.....	350,000 tons
Total.....	<u>3,730,000 tons</u>

Gasoline and diesel-oil sales are closely correlated with autos and trucks in circulation. Fuel-oil and derivatives have shown an increase of 2 percent and 5 percent, respectively, for each of the past 3 years and are expected to continue this rate of increase in 1963. In 1962, there were 1,800,000 cars in circulation in Italy and 150,000 diesel trucks. Projections made by the automotive industry for 1963 are 2,000,000 cars and 160,000 trucks in circulation.

Gasoline and diesel-oil sales are heaviest during the summer months. This is offset by higher seasonal sales of fuel oil during the winter months. Derivative sales are approximately the same each month. As a percentage of the annual sales, during the month of January gasoline sales generally amount to 6.5 percent, diesel oil 7 percent, and fuel oil 30 percent.

Selling prices per ton are gasoline \$46, diesel oil \$32, and fuel oil \$23, and derivatives average \$30.

Monthly production is planned to equal budgeted monthly sales. However, because of the large stocks of gasoline and diesel oil on hand at December 31, 1962, monthly production of these items during the first half of 1963 is scheduled at 20 percent less than the expected sales for the month. Ten percent of the fuel oil produced each month is used to operate the refinery, and 1 percent of the total crude-oil throughout is lost in production. Fuel oil consumed at the refinery is included in overhead, but only at the cost of the crude-oil content. Of the total crude oil used, 50 percent is represented by Kuwait oil at \$22 per ton, 10 percent by Syrian oil at \$23 a ton, 15 percent by Iranian oil at \$21, and 25 percent by Arabian oil at \$22.50 per ton.

Refinery conversion costs per month, based on 50 to 100 percent of capacity, are estimated as follows:

	<i>Fixed</i>	<i>Variable</i> (per throughput ton)
Maintenance salaries.....	\$ 6,000-	\$ .006
Maintenance supplies.....	3,000-	.007
Chemicals.....	-0-	.02
Salaries and wages.....	9,000-	-0-
Power.....	5,000-	.007
Water.....	7,500	-0-
Compressed air.....	1,000	-0-
Refinery depreciation.....	320,000	-0-
Storage costs.....	200,000	-0-
Personnel department.....	70,000	-0-
Refinery administration.....	90,000	-0-

Selling and administrative expenses are estimated at \$1,400,000 fixed plus 2 percent of sales.

*Required:* Prepare the company's profit plan for the month of January, 1963, assuming that the refinery uses the last-in, first-out method for costing its sales. Work in process at beginning and end of month is to be ignored. Refinery costs are allocated to products on the basis of the sales value of production.

- 16-13 *Analysis of gross profit variation.* Operating profits of the Barrow Manufacturing Company for the years ended December 31, 1947 and 1948, were as follows:

Particulars	Year ended Dec. 31	
	1947	1948
Net sales.....	\$482,961.87	\$679,241.64
Cost of sales.....	431,827.61	503,645.59
Gross profit.....	\$ 51,134.26	\$175,596.05
General expenses.....	76,258.72	89,533.28
Net profit.....	<u>\$ 25,124.46*</u>	<u>\$ 86,062.77</u>

\* Red.

At the end of 1947 the management became convinced that an increase in the selling price of the product was necessary if future losses were to be avoided. Accordingly, a general increase of 15 percent was made on all selling prices, effective January 1, 1948. At the same time a new plant manager was installed who gave much of his attention during the year to reducing plant costs.

A dispute has arisen between the new plant manager and the vice-president in charge of sales. Both admit that the increase in profits during 1948, as compared with 1947, was due principally to the increase of 15 percent in selling prices; but the plant manager insists that savings in factory costs were greater in amount than the increase in gross profits due to the increased volume of sales (i.e., increased quantity of goods sold, as distinct from the increase in selling prices), while the vice-president is equally insistent that the opposite is the case.

You are called upon to settle the dispute. Ascertain the amount of increase in gross profit attributable to each of the three factors mentioned.

(AICPA)

- 16-14 *Reasons for gross profit variation.* The president of the Farmbrook Manufacturing Company is concerned because his budgeted gross profit for the month is \$130,000 and the actual \$87,960. He asks you to prepare an analysis of the causes.

You find that the company operates two plants, each as a separate unit. Investigation reveals the following:

	Actual	Budget
Plant 1 (makes a variety of products):		
Sales.....	\$200,000	\$300,000
Cost of sales.....	160,000	210,000
Gross profit.....	<u>\$ 40,000</u>	<u>\$ 90,000</u>

	Actual		Budget	
	Amount	Per unit	Amount	Per unit
Plant 2 (makes only one product):				
Sales .....	\$112,200	\$10.20	\$100,000	\$10.00
Cost of sales .....	64,240	5.84	60,000	6.00
Gross profit .....	\$ 47,960	\$ 4.36	\$ 40,000	\$ 4.00

*Required:* Prepare a detailed analysis of the causes for the variation in gross profit for each plant, to the extent that the above data permit such an analysis.

(AICPA adapted)

- 16-15 *Analysis of changes in gross profit.* The Boylston Manufacturing Company earned a gross profit of \$70,000 in 1960 and of \$37,000 in 1961. It wishes to know what has caused the decline of \$33,000. It furnishes the following information:

	1960	1961
Net sales:		
Product A .....	\$100,000	\$120,000
Product B .....	50,000	40,000
Product C .....	25,000	25,000
	<u>\$175,000</u>	<u>\$185,000</u>
Cost of sales .....	105,000	148,000
Gross profit .....	<u>\$ 70,000</u>	<u>\$ 37,000</u>

The quantity and quality of raw materials entering into each unit of product have remained unchanged throughout the two years. No inventories were on hand at the beginning or end of either year.

Scrap from the fabrication of products A and B is the raw material for product C. Product C has been treated as a by-product, and the cost of raw material entering into it has been regarded as an amount equal to its selling price less the direct labor expended in making it a marketable product. This cost has been credited four-fifths and one-fifth, respectively, to the materials costs of products A and B, for the reason that the proportion of scrap material from the fabrication of the two major products has been 4 to 1.

Upon analysis of the books the following cost data were extracted from the production accounts:

Cost of Production in 1960					
	Units	Material	Labor	Overhead	Total
Product A .....	500	\$40,000	\$10,000	\$10,000	\$ 60,000
Product B .....	2,500	10,000	5,000	5,000	20,000
Product C .....	1,000	16,000	9,000	—0—	25,000
		<u>\$66,000</u>	<u>\$24,000</u>	<u>\$15,000</u>	<u>\$105,000</u>

Cost of Production in 1961					
	Units	Material	Labor	Overhead	Total
Product A .....	600	\$60,000	\$15,000	\$15,000	\$ 90,000
Product B .....	1,600	13,000	10,000	10,000	33,000
Product C .....	1,250	10,000	15,000	—0—	25,000
		<u>\$83,000</u>	<u>\$40,000</u>	<u>\$25,000</u>	<u>\$148,000</u>

Because of the confusion that would otherwise enter into the comparison, it was agreed with the management that the raw material in each unit of product C manufactured and sold during both years should be considered as costing \$8. It was also agreed to redistribute overhead to the three products on a direct-labor cost basis.

*Required:* Prepare a statement showing to what extent the decline in the gross profit was attributable to changes in sales volume, prices, and production costs. Show computations of adjusted unit costs.

(AICPA)

- 16-16** *Causes for variations from profit plan.* The Pursglove Manufacturing Corporation produced a single product called Fliplo. A comparison between its actual performance and its profit plan for the month of February appears in Exhibit I.

The company used Lifo for costing its inventories. There were no inventories of work in process at the beginning or end of the period. Fliplo on hand on January 31 consisted of 8,000 units at a cost of \$32,000. The budgeted production for the month was 24,000 units of Fliplo, and the actual production was 22,500 units. The standard cost of Fliplo was as shown in Exhibit II.

Purchase price variances are computed as materials are used. During the month, 62,500 pounds of Calso was withdrawn from the stock room at a cost of 45 cents per pound. Actual direct labor amounted to \$20,250 (10,125 hours @ \$2 per hour). Actual overhead during February amounted to \$47,250 (\$30,000 fixed and \$17,250 variable).

### Exhibit I

#### PURSGLOVE MANUFACTURING COMPANY Income Statement Comparison of Actual Profit and Profit Plan For the Month of February, \_\_\_\_\_

	Actual (22,000 units)	Profit plan (24,000 units)
Sales.....	\$136,400	\$144,000
Cost of sales:		
Materials.....	\$ 27,500	\$ 36,000
Labor.....	19,800	24,000
Variable overhead.....	16,874	18,000
Fixed overhead.....	29,326	30,000
Total.....	\$ 93,500	\$108,000
Gross profit.....	\$ 42,900	\$ 36,000
Less: Selling and administrative expenses		
Selling and promotion.....	\$ 11,200	\$ 9,500
Warehousing and distribution.....	16,400	12,400
Administrative.....	8,100	7,500
Total.....	\$ 35,700	\$ 29,400
Profit before income taxes.....	\$ 7,200	\$ 6,600



**Exhibit II****Flipo—Standard Cost**

Raw materials (3 lb of Calso @ \$.50 per lb).....	\$1.50
Direct labor (.5 hr per unit @ \$2 per hr).....	1.00
Variable overhead (\$.75 per unit).....	.75
Fixed overhead $\left( \frac{\text{monthly fixed charges } \$30,000}{\text{budgeted monthly production } 24,000} \right)$ .....	1.25
<b>Total</b> .....	<b>\$4.50</b>

*Required:* Prepare an analysis which indicates all possible causes for the \$600 variation between the profit plan and actual profit.

- 16-17 *Industry market, share of market, price, and mix variances.* The battery division of the American Auto Supply Corporation sold two lines of batteries, car batteries and truck batteries. A comparison between the budgeted and actual gross profit for the entire division and for each product line appears in Exhibits I, II, and III.

**Exhibit I**

**AMERICAN AUTO SUPPLY CORPORATION**  
**Battery Division**  
**Budgeted and Actual Gross Profit**  
**For the Year Ended December 31, 1962**

	<i>Units</i>	<i>Budget Per unit</i>	<i>Amount</i>	<i>Units</i>	<i>Actual Per unit*</i>	<i>Amount</i>
Sales.....	300,000	\$40.-	\$12,000,000	290,000	\$39.17	\$11,360,000
Cost of sales....		26	7,800,000		25.45	7,380,000
Gross profit....		\$14	\$ 4,200,000		\$13.72	\$ 3,980,000

\* Rounded.

**Exhibit II**

**AMERICAN AUTO SUPPLY CORPORATION**  
**Battery Division—Cars**  
**Budgeted and Actual Gross Profit**  
**For the Year Ended December 31, 1962**

	<i>Units</i>	<i>Budget Per unit</i>	<i>Amount</i>	<i>Units</i>	<i>Actual Per unit</i>	<i>Amount</i>
Sales.....	100,000	\$30.-	\$3,000,000	110,000	\$28.-	\$3,080,000
Cost of sales....		18	1,800,000		18	1,980,000
Gross profit.....		\$12	\$1,200,000		\$10	\$1,100,000

**Exhibit III****AMERICAN AUTO SUPPLY CORPORATION****Battery Division—Trucks****Budgeted and Actual Gross Profit****For the Year Ended December 31, 1962**

		<i>Budgeted</i>			<i>Actual</i>	
	<i>Units</i>	<i>Per unit</i>	<i>Amount</i>	<i>Units</i>	<i>Per unit</i>	<i>Amount</i>
Sales.....	200,000	\$45.-	\$9,000,000	180,000	\$46.-	\$8,280,000
Cost of sales.....		30	6,000,000		30	5,400,000
Gross profit.....		\$15	\$3,000,000		\$16	\$2,880,000

The battery division's budgeted sales were based on obtaining 20 percent of an estimated industry market of \$60,000,000. Actually, the industry's sales of comparable batteries amounted to \$65,000,000.

*Required:* Calculate the budget variances due to industry market, share of market, price, and mix.

- 16-18** *Analysis of gross profit variance.* Shortly after the close of the year, Art Golden, controller of Artistic Lamps, Inc., received the following telephone call from Steve Pullen, the president. "Art, I just got finished complimenting Al Case (sales manager) about his sales performance for last year. According to your report (Exhibit I), the company's actual sales were \$277,000 over the profit plan. Although it is quite apparent that Al and his salesmen did a good job, I'm rather puzzled about your figures. Your income statement shows the actual gross profit at standard cost as being \$43,000 less than the profit plan. How can this be possible when sales were \$277,000 over the profit plan? Did you make an error? Please check the figures and advise me as soon as possible."

In preparing his answer to the president, Art Golden made the calculations shown in Exhibit II.

**Exhibit I****ARTISTIC LAMPS, INC.****Sales Report****For the Year Ended December 31, 1962**

<i>Product line</i>	<i>Profit plan</i>			<i>Actual</i>			<i>Actual over or (under)</i>
	<i>Quantity</i>	<i>Average price</i>	<i>Amount</i>	<i>Quantity</i>	<i>Average price</i>	<i>Amount</i>	
A	100,000	\$15-	\$1,500,000	90,000	\$14.50	\$1,305,000	\$(195,000)
B	250,000	16-	4,000,000	270,000	16.-	4,320,000	320,000
C	200,000	11-	2,200,000	240,000	10.80	2,592,000	392,000
D	50,000	24-	1,200,000	40,000	24.-	960,000	(240,000)
	600,000		\$8,900,000	640,000		\$9,177,000	\$ 277,000

*Exhibit II*ARTISTIC LAMPS, INC.  
Data Compiled by Controller

<i>Product line</i>	<i>Budgeted average selling price</i>	<i>Average standard factory cost</i>	<i>Average standard variable cost*</i>	<i>Budgeted average gross profit</i>	<i>Average contribution margin</i>	<i>Direct-capital investment</i>
A	\$15	\$10	\$ 8	\$ 5	\$ 7.-	\$ 700,000
B	16	12	12.50	4	3.50	2,500,000
C	11	8	8.25	3	2.75	1,400,000
D	24	14	12.-	10	12.-	600,000
						\$5,200,000

\* Includes variable selling and administrative.

*Required:* If you were the controller, what type of analysis would you send to the president?

## 17. **Use of Costs in Pricing Decisions**

Product pricing is a complicated process involving many considerations. Cost is but one factor, although a significant one. Among the noncost factors affecting pricing are the nature of the industry, degree of inter- and intra-industry competition, elasticity of demand, economic conditions, financial status of the firm, product characteristics, institutional patterns, level of plant activity, government restrictions, and inventory accumulations.

It is beyond the scope of this book to evaluate the importance of these noncost factors in pricing decisions. Our concern is with the use of cost data. Nevertheless, it should be stressed at the outset that a purely cost approach to pricing is unrealistic. The firm may be confronted with an existing market price structure. In such situations, the cost-price relationship tends to become inverted. Instead of acting as the basis for pricing, costs serve to measure the desirability of accepting or rejecting business at the prevailing price level.

Several cost-pricing procedures are discussed in this chapter. Pricing procedures are merely instruments for achieving management's objectives and stated policies. Pricing policy may be aimed at long-term growth, short-term excess profits, meeting competition, penetrating new markets, earning a fair return on investment, etc. This, of course, assumes the existence of clearly defined pricing policies, which frequently do not exist. Even when management has established pricing policies, there is no assurance that they will be implemented by lower-level pricing executives.

### *Economic price theory*

Price theory long has constituted the main stream of economic thought. Economics is concerned with the manner in which resources are allocated among alternative possible uses. In a competitive economy, this is accomplished largely by means of the market price. In an unfettered

market, price acts as a kind of omniscient regulator of the exchange process.

Classical economic theory is based upon the concept of pure competition. Under pure competition, an equilibrium market price is achieved when the price at which the quantity of goods demanded by consumers equals the quantity offered by suppliers. If an excess of supply exists, prices will decline. If more goods are demanded by consumers than are available, prices will rise.

Pure competition occurs (1) when a sufficiently large number of buyers and sellers exist to preclude market control by an individual or group of buyers or sellers, (2) when the products supplied are homogeneous or perfectly substitutable, (3) when the factors of production are mobile and can shift toward the industry or firm which offers the highest return, (4) when there are no impediments to free entry or departure of firms to or from an industry, and (5) when all sellers and buyers are fully informed about market conditions.

In terms of modern conditions, the assumptions underlying the theory of pure competition are unrealistic. There are virtually no industries in which a free market exists. Contemporary economists of course are aware of these market imperfections. Joan Robinson, a leading English economist, has stated that "... the traditional assumption of perfect competition is an exceedingly convenient one for simplifying the analysis of price, but there is no reason to expect it to be fulfilled in the real world."<sup>1</sup> The theory of pure competition merely provides a useful model for purposes of economic analysis.

### Demand factors

Each business is confronted by a demand schedule for its products. This schedule reflects the collective desires of consumers for particular products at varying price levels. The quantity demanded normally increases as price declines and decreases with rises in price. Economists have developed theoretical explanations of the forces that underlie the demand schedule. Such theories, however, generally are of less interest to pricing executives than are two other aspects of demand, namely, elasticity and shifts in demand.

The quantity demanded of different products does not respond in the same manner to price changes. The extent to which the quantity demanded of a particular product varies with changes in price is referred to by economists as *elasticity of demand*. In practice, elasticity of demand rarely can be measured. It is affected by many factors, including the availability of substitutes, degree of competition, buying habits, advertising expenditures, and disposable income. Elasticity of demand does not remain constant but shifts with time. It also varies in different geographical locations.

<sup>1</sup> Joan Robinson, *Economics of Imperfect Competition* (London: Macmillan & Co., Ltd., 1948), p. 88.



Despite these difficulties in measuring the elasticity of demand, attempts to predict buyers' reactions to price revisions remain the focal point of product pricing. While businessmen can experiment with price changes only to a limited extent, some experimentation can and does take place. A company may vary its prices in a selected geographical area, or it may conduct market research among its customers to ascertain their reaction to contemplated price changes. Consciously or unconsciously business executives cannot avoid considering elasticity of demand in pricing their products.

The nature of a demand schedule may be indicative of the importance of costs in pricing. When demand for a product is inelastic, i.e., when quantity demanded does not react to price changes, and prices are not subject to governmental regulation, cost increases can more readily be transferred to customers in the form of price increases. In such situations, the cost accountant should be concerned with showing the impact of cost increases on profits and the effect of proposed price changes.

When the demand for a product is relatively elastic, the cost accountant should be more interested in preparing reports which reveal the cost-volume-profit relationship at different price levels. When there is an existing market price and the firm has little price discretion, costs exercise a negligible influence on a firm's product prices. However, they are still important in decisions as to whether or not to manufacture certain products and in revealing which products are most profitable and should be "pushed."

A shift in demand alters the demand schedule. At each price level the quantity demanded will be somewhat higher or lower than formerly. Shifts in demand may be caused by changing consumer preferences, increases or decreases in income, changes in tax rates, and long-range population trends. Shifts in demand are important to pricing executives. Business managers attempt to induce favorable shifts in demand in order to maximize profits. This may be accomplished through product improvement, advertising, and sales promotion. These efforts will be successful if the resultant increase in revenue exceeds the additional cost outlays. In practice, predicting the effect on volume of such expenditures is very difficult if not impossible. Indeed, most business managers, in planning their selling-expense outlays, rely on "hunches" or rough estimates of the potential benefits rather than attempt to calculate marginal selling costs and marginal revenues.

The importance of elasticity and shifts in demand lies in their effect on the cost-volume-profit relationship. The very existence of a demand schedule compels business executives to look beyond the cost data in setting prices. They normally will try to arrive at a price which will permit the company to operate at the most profitable level.

### Supply factors

Supply consists of a schedule of the quantity of goods that sellers are willing to offer at various price levels. According to economic theory, the

long-run supply price equals the cost of production, inclusive of a fair return on investment. This is necessary in order for the firm to remain in business.

In the short run, profits are maximized at that price at which the firm's marginal cost equals its marginal revenue, i.e., the price at which the increase in total cost of the last unit produced is equal to the increase in total revenue derived from its sale. At any lower price, the marginal cost would exceed the marginal revenue, and a loss on the last unit would occur, an obvious disadvantage to the seller. At any higher price, a profit would be realized on the marginal unit, thus making it desirable for the supplier to add to his total profits by increasing output. The point at which the marginal cost and marginal revenue curves intersect is the only price from which a change would not benefit the producer. This price represents the point of profit maximization to the supplier.

These concepts are based on pure competition. However, the real world is characterized by imperfect competition. How then does a supplier set prices in oligopolistic, monopolistic, and monopolistically competitive situations?

In oligopolistic markets, a few firms sell a uniform product. Oligopolistic industries, e.g., oil, gasoline, copper, steel, generally are characterized by unusual price stability. This is because (1) little incentive exists to reduce prices, since competitors almost are certain to retaliate, and (2) rival firms may refrain from matching price increases. When price changes occur, generally they are caused by cost pressures which affect the entire industry, such as new labor contracts, interindustry or foreign competition, or rise in raw materials prices.

A monopolistic situation is one in which competition among suppliers does not exist. Traditional economic theory indicates that a firm will maximize its profits by operating at a level at which its marginal costs are equal to its marginal revenue. Included in these economic costs is an allowance for normal profit which represents a return on invested capital.

A monopoly, however, may earn supernormal profits by establishing excessive prices and restricting output. Actually, a number of influences exist to restrain the establishment of "monopoly prices." Government participation in monopoly rate setting is common, particularly among public utilities. Fear of public reaction and government intervention also may impede the setting of excessive prices. Moreover, unless a natural monopoly or other restrictions to free entry exist, abnormal profits may act as an incentive for other firms to enter the industry. Finally, the elasticity of demand may make it economically desirable to reduce prices and increase output, thus reducing unit costs and increasing total profits.

In monopolistically competitive markets, despite competition, sufficient product differentiation is presumed to exist to permit sellers some freedom of action in establishing individual product prices. There can be no industry-wide equilibrium price in such industries. Buyers must,

of course, be convinced that product differences really exist. Firms accomplish this by means of advertising. Increases in output under monopolistic competition are not necessarily accompanied by, or a consequence of, rising prices. Such increases in production may result from price decreases in an effort to eliminate idle capacity and reach a level at which profits can be maximized.

The extent to which costs may be utilized in pricing varies with the nature and the degree of competition, as well as with elasticity and shifts in demand. Among monopolistic firms cost fluctuations would tend to have a more direct and immediate effect on prices than under conditions of active competition.

Pricing policies are affected by many other supply factors. The nature of the product manufactured is important. The short-run prices of primary raw materials such as minerals, petroleum, grains, and meats are largely dependent on the existing supply and demand at the time of sale rather than on costs. In such industries, the production commitment cycle may be relatively long, and by the time the products have reached the market place, costs may have become dead issues. The prices of products of this type also are generally influenced by international as well as national supply and demand conditions.

In many industries, where joint products are fabricated, supply costs cannot be calculated in any meaningful manner, at least not from a pricing standpoint. In joint cost industries it is the combined cost of all products in relation to total revenue rather than the cost-price relationship of individual products that is important.

Prices are greatly influenced by competing interindustry products, e.g., poultry versus meat and fish. Prices also are affected in countless ways by government policies. The influence of governmental authorities on pricing may be direct, as, for example, price subsidies, price ceilings, and fair trade regulations, or it may be indirect through general fiscal and monetary activities.

### Challenges to economic price theory

Economic price theory is based upon marginal cost and revenue concepts. Some economists, however, have challenged the validity of the marginal theory of the firm, at least in regard to short-run pricing and related decisions. Their attacks are based upon the following arguments:

1. That businessmen are ignorant of the elasticity of demand for their products.<sup>2</sup>
2. That "... the practical problems involved in applying marginal analysis to the multi-process operations of a modern plant seem insuperable, and business executives rightly consider marginalism impractical as an operating principle in such manufacturing establishments."<sup>3</sup> Conse-

<sup>2</sup> See R. F. Harrod, *Price and Cost in Entrepreneur's*, Oxford Economic Papers no. 2, May, 1939, pp. 4-5.

<sup>3</sup> Richard A. Lester, "Shortcomings of Marginal Analysis for Wage-Employment Problems," *American Economic Review*, March, 1949, p. 8.



quently, they tend to rely to a considerable extent on average rather than marginal costs.

3. That as a firm approaches full capacity, contrary to economic theory, unit costs either remain relatively constant or decline.<sup>4</sup>

4. That businessmen do not always attempt to maximize profits.<sup>5</sup>

Fritz Machlup<sup>6</sup> has responded to these criticisms of traditional economic theory with the following arguments:

1. That the alleged inapplicability of marginal analysis often is due to a failure to understand it, to faulty research techniques, or to mistaken interpretations of findings.

2. That instead of giving a complete explanation of the determination of output, prices, and employment by the firm, marginal analysis really intends to explain the effects which certain changes in conditions may have upon the actions of the firm.

3. That one must not assume that all producers "really" know their costs in the sense in which an efficiency expert would determine it; several of them may lack the interest or experience; they may not find it worth their while to dig too deeply into the mysteries of their business. (After all, we know that there are good businessmen and bad, and that the majority are somewhere between good and bad.) But this does not invalidate the proposition that the producer is guided by marginal cost.

4. That a businessman is motivated by considerations other than the maximization of money profits does not necessarily make his conduct "uneconomical." The economics theorist finds no difficulty in fitting into the pattern of economical conduct the householder and consumer who make donations to friends or the church, or the seller of labor services who chooses a badly paying but less strenuous job in preference to one that pays more but calls for more exertion.

5. That the average cost figures, in spite of their prominent place in our businessman's complicated statement, plays no part in his actual decision. The decision is based on the profitableness of the added business. When not only the current but also the potential average cost—that is, the average cost at a different production volume—and also the change in total receipts are considered, then the reasoning is true marginal calculus, not average cost reasoning, as some mistakenly believe.

Contemporary economists are aware of the limitations of classical

<sup>4</sup> See Joel Dean, *Statistical Determination of Costs with Special Reference to Marginal Costs* (Chicago: The University of Chicago Press, 1936); *Statistical Cost Functions of a Hosiery Mill Belt Shop* (Chicago: The University of Chicago Press, 1941); and *The Relation of Cost to Output for a Leather Belt Shop* (New York: National Bureau of Economic Research, 1941). See also Henry M. Oliver, Jr., "The Relationship between Total Output in Manufacturing Industry," *Quarterly Journal of Economics*, February, 1941; and M. Ezekiel and K. H. Wylie, "Cost Functions for the Steel Industry," *Journal of the American Statistical Association*, March, 1941.

<sup>5</sup> R. A. Gordon, "Short-period Price Determination in Theory and Practice," *American Economic Review*, June, 1948, pp. 269-271; see also Richard A. Lester, "Equilibrium of the Firm," *American Economic Review*, March, 1949, p. 483.

<sup>6</sup> Fritz Machlup, "Marginal Analysis and Empirical Research," *American Economic Review*, September, 1946.

economic theory, despite the logic of the underlying assumptions. This does not deny its usefulness. It has provided a framework for empirical price studies. While numerous studies of pricing have taken place, an acceptable alternative price theory has not yet been produced.

### **Types of costs required in pricing decisions**

There is a tendency either to underrate or overrate the importance of costs in pricing. The statements frequently heard that "prices are based on competition" or "prices are based on costs" are equally untrue. Both costs and competition are important in pricing strategy.

In many situations, costs may have little direct impact on pricing. In joint cost industries, in fact, prices often tend to establish costs rather than the reverse. However, rarely can costs be entirely ignored. Even where the influence of costs in pricing is not immediate, they generally have a strong supporting role in related decisions, such as whether to introduce a new product, which items to push, and establishment of price differentials.

To the extent that costs may be used in pricing, what kinds of costs are required? Unmodified accounting costs will not suffice. In decision making, costs must be purposive; they must be selected with a view toward solving the specific problem under consideration. Certain modifications of accounting costs are necessary in pricing decisions.

All decisions are concerned with the future. Costs for decision making must be prospective rather than retrospective. Prices should recover costs expected to be incurred during the pricing period. How can this be accomplished?

One large company establishes prices by means of a top-level committee in which different functional executives participate. It is the responsibility of these officials to present data regarding the probability of cost changes in their respective areas, as, for example, raw materials, personnel, advertising. In such a setting, the role of the cost accountant is important. He must be prepared to trace the effect of these future cost expectations on the company's revenue-cost-profit relationship.

One of the most glaring deficiencies in the use of costs for pricing is the inclusion of depreciation based on the acquisition cost of the assets in use. Apart from the merit or lack of merit of the financial accountant's adherence to original cost for income measurement, product prices provide the funds not only for income distributions and growth but also for the replacement of assets. Yet, only a handful of companies presently give effect to replacement costs in the data provided to pricing executives.

An uncritical use of plant-overhead rates in setting prices is dangerous. Admittedly, the use of overhead rates tends to assure the recovery of total costs in the long run. However, plant-overhead rates generally do not segregate fixed and variable costs, which is important in short-run pricing decisions.

The accountant fails to give recognition to imputed-interest cost. Yet,



there is nothing theoretical about imputed interest on invested capital in certain pricing situations. In heavily mechanized and product-diversified companies, failure to include provision for interest on capital may produce an unbalanced price structure.

### *Cost-pricing methods*

Although many rule-of-thumb procedures are utilized by pricing executives, this discussion will be concerned only with the more refined of the cost-pricing methods. They are:

1. Full-cost pricing
2. Conversion-cost pricing
3. Marginal-cost pricing
4. Return-on-investment pricing
5. Flexible costing
6. The learning curve in cost estimating

#### **Full-cost pricing**

Selling prices which are established on the basis of full costs are equal to the total factory cost (i.e., absorption cost) plus an addition for selling and administrative expenses and a desired profit margin. Either actual or standard costs may be used, provided they are adjusted for expected cost trends.

A condensed product cost statement prepared under the full-cost method for a company which manufactures two products and desires a 30 percent profit on costs (before taxes), appears in Exhibit 17-1.

The factory-overhead rates and selling and administrative overhead rates were established on the basis of sales expectations rather than

*Exhibit 17-1*

**Full-cost Pricing Method**

	<i>Product X</i>	<i>Product Y</i>
Raw materials (quantities required $\times$ net prices).....	\$ 8.00	\$ 3.00
Direct labor (hours required $\times$ hourly rate).....	3.00	6.00
Factory overhead (200% of direct labor).....	6.00	12.00
Cost to make.....	\$17.00	\$21.00
Selling and administrative expenses (20% of cost to make).....	3.40	4.20
Cost to make and sell.....	\$20.40	\$25.20
Profit margin before taxes (30% of cost to make and sell)	6.12	7.56
Proposed selling price.....	\$26.52	\$32.76

*Exhibit 17-2*

## Computation of Overhead Rates under Full Costing

			<i>Overhead rates</i>
Materials:			
X (20,000 units @ \$8).....	\$160,000		
Y (30,000 units @ \$3).....	90,000	\$ 250,000	
Direct labor:			
X (20,000 units @ \$3).....	\$ 60,000		
Y (30,000 units @ \$6).....	180,000	240,000	
Estimated factory overhead at budget level.....		480,000	
Factory overhead as percentage of direct labor.....			200 %
Estimated cost to make.....		\$ 970,000	
Estimated selling and administrative expenses at budget level.....		194,000	
Selling and administrative expenses as percentage of cost to make.....			20 %
Estimated cost to make and sell.....		<u>\$1,164,000</u>	

normal factory capacity. It is estimated that this company will sell 20,000 units of X and 30,000 units of Y during the forthcoming year. The computation of these overhead rates appears in Exhibit 17-2.

World War II created a considerable impetus toward the use of "cost-plus" as a basis for pricing. During this period, we not only had government cost-plus-fixed-fee contracts, in which the sales price was based on costs, but also price control, which sanctioned price increases according to prescribed cost formulas. Throughout the war and during the immediate postwar period an unprecedented demand existed which permitted management to establish prices at cost plus a satisfactory profit.

The full-cost approach to pricing is more relevant among firms whose products are clearly differentiated, among companies manufacturing custom-made products, and for new products where an established market price does not exist. Full-cost pricing thus has greater applicability to less competitive than to more competitive products. Even in highly competitive markets, the full-cost method is used to determine product profitability and related decisions.

The principal advantage of the full-cost method is that it assures total cost recovery and the earning of a planned profit margin. This is particularly important in long-run pricing. The widespread use of this method, with its emphasis on total cost recovery, tends to introduce a certain degree of price stability into the market. Despite its popularity, the full-cost method has serious limitations:

First, it ignores elasticity of demand. Admittedly, demand cannot be calculated readily, but a pricing system which is entirely dependent on costs can hardly be realistic for most businesses. It is probable that the

majority of companies that purport to use the full-cost method actually make adjustments in their pricing computations for market conditions.

Second, it fails to give consideration to competition. A business concern cannot operate in a vacuum. It should not assume that its functions are necessarily being performed at maximum efficiency and that lower prices of competitors can be ignored. This would result in perpetuating existing inefficiencies and incorporating them into its price structure. Instead, a firm should constantly strive to reduce its costs so that its prices will be equal to, or lower than, competition and still provide a satisfactory profit.

Third, the full-cost method does not distinguish between fixed and variable costs. A firm using this method would be inclined to reject orders which do not at least cover total product costs. The acceptance of such business actually may result in increased profits, provided the incremental costs relevant to the order are at least covered.

Fourth, in the full-cost method a flat percentage is applied to product cost to provide for profit. This fails to recognize that not all products can earn profit at the same rate.

### Conversion-cost pricing

Under the full-cost method, the profit for each product is computed as a percentage of the total product cost. The profit for two different products would be equal if their total costs were equal. This occurs even if a wide disparity exists in the relationship between their conversion costs (labor and overhead) and material content. In Exhibit 17-3 the same data have been recast in a slightly different form.

*Exhibit 17-3*

#### Full-cost Pricing Return-on-sales Method

	Product X		Product Y	
	<i>Per unit</i>	<i>Percent of sales price</i>	<i>Per unit</i>	<i>Percent of sales price</i>
Raw materials.....	\$ 8.00	30.2	\$ 3.00	9.2
Conversion costs (labor and overhead).....	9.00	33.9	18.00	54.9
Cost to make.....	\$17.00	64.1	\$21.00	64.1
Selling and administrative expense.....	3.40	12.8	4.20	12.8
Cost to make and sell.....	\$20.40	76.9	\$25.20	76.9
Profit margin before taxes (30%).....	6.12	23.1	7.56	23.1
Proposed selling price.....	\$26.52	100.0	\$32.76	100.0

It is apparent that both products show an identical return on sales (23.1 percent). However, there is a significant difference in the composition of the factory costs. A substantially greater portion of the factory cost of product X consists of purchased materials (30.2 versus 9.2 percent) and a much smaller percentage of conversion costs (33.9 versus 54.9 percent). This means that it will be more costly and require more time to convert a unit of Y than a unit of X. In view of the equality of profit margins but the more rapid conversion time of product X, it would be more advantageous for the company to push X than to push Y.

Proponents of the conversion-cost method of pricing maintain that profits should be based only on the value added by manufacturing cost, i.e., conversion costs, and that purchased materials should earn no profit. Because of product Y's greater need for factory labor and facilities, advocates of conversion costing contend that the production of such items, in comparison with product X, can be justified only by a commensurably higher selling price. This can be accomplished if the profits are based on conversion costs rather than total product costs. The effect of conversion-cost pricing, as contrasted with full costing may be seen in Exhibit 17-4.

It is clear that if the profit computed under conversion costing is equal to 68 percent of the conversion costs, then the selling price of X will be identical under the two methods. However, because of product Y's proportionately greater conversion costs, the profit margin and selling price will be \$4.68, or 11.2 percent greater under conversion costing than under full costing.

Conversion-cost pricing is used most commonly in industries where

*Exhibit 17-4*

Comparison of the Full-cost and Conversion-cost Methods for Pricing Products

	<i>Product X</i>		<i>Product Y</i>	
	<i>Full cost</i>	<i>Conversion cost</i>	<i>Full cost</i>	<i>Conversion cost</i>
Raw materials.....	\$ 8.00	\$ 8.00	\$ 3.00	\$ 3.00
Conversion costs.....	9.00	9.00	18.00	18.00
Selling and administrative.....	3.40	3.40	4.20	4.20
Total cost to make and sell....	\$20.40	\$20.40	\$25.20	\$25.20
Profit under full costing (30% cost to make and sell)....	6.12		7.56	
Profit under conversion costing (68% of conversion costs)...		6.12		12.24
Proposed selling price.....	\$26.52	\$26.52	\$32.76	\$37.44

the nature and cost elements of the items produced vary to a considerable extent. However, most companies that use costs as a basis for setting prices are unwilling to accept the principle that purchased materials should earn no profit.

### Marginal-cost pricing

"Marginal," or "differential," costs are added costs that can be directly associated with a particular product, product line, or other segment of a business. They are costs which would not be incurred if a product were eliminated. From a pricing standpoint, they generally include variable costs and the variable element of semivariable costs. Exhibit 17-5 shows how product X of our previous examples would appear under marginal costing.

The out-of-pocket recovery price is the minimum price below which a cash loss will be sustained. The product-carrying price may be regarded as the long-run minimum price necessary to recover the cash costs as well as those fixed costs directly related to the manufacture and distribution of a product. It may be thought of as the price at which a product pays for itself. The full-cost recovery price represents the desired minimum long-run price which will permit the product to recover its direct costs as well as its proportionate share of the company's over-all fixed costs.

From a pricing standpoint, the essential difference between marginal costing and full costing is in the concept of cost recovery. Under full costing, prices are expected to cover total costs, inclusive of fixed charges. Under marginal costing, any contribution toward the recovery of fixed costs is better than none at all. Pricing under marginal costing is more flexible than full-cost pricing. Under marginal costing a pricing executive has more latitude. His objective is to discover the price and volume which will maximize profits, provided the price is at least greater than the marginal, or out-of-pocket, costs.

### Exhibit 17-5

#### Marginal-cost Pricing Method

	<i>Product X</i>
Raw materials.....	\$ 8.00
Direct labor.....	3.00
Variable factory overhead.....	2.25
Variable selling and administrative.....	.75
Total marginal costs (out-of-pocket recovery price)...	\$14.00
Fixed costs directly chargeable to product.....	2.80
Total marginal and direct fixed costs (product-carrying price).....	\$16.80
Allocated fixed costs.....	3.60
Total product costs (full-cost minimum recovery price)	\$20.40



*Exhibit 17-6*

## Comparison of Marginal- and Full-cost Pricing Methods

	<i>Per unit</i>
<b>Under full costing:</b>	
Full cost to make and sell (Exhibit 17-1) .....	\$ 20.40
Special packaging .....	\$ .80
Total cost to make .....	\$ 21.20
Quoted price .....	\$ 16.50
Loss per unit .....	\$ 4.70
Quantity demanded .....	5,000
Total loss .....	\$(23,500.00)
<b>Under marginal costing:</b>	
Marginal cost to make (Exhibit 17-5) .....	\$ 14.00
Special packaging .....	\$ .80
Total marginal cost to make .....	\$ 14.80
Quoted price .....	\$ 16.50
Contribution toward fixed costs and profit .....	\$ 1.70
Quantity demanded .....	5,000
Total contribution .....	\$ 8,500.00

The greater flexibility of marginal costs is illustrated in Exhibit 17-6. It will be assumed that our mythical company receives an offer for the purchase of 5,000 units of X at \$16.50, at a time when excess plant capacity exists. Acceptance of the order would require the company to incur additional packaging costs of \$4,000. Under full costing, there would be a strong tendency to reject this order, since the quoted price is less than the total unit cost and a loss of \$23,500 would occur. Under differential costing the order would be accepted, since it would contribute an additional \$8,500 of revenue toward fixed costs.

Marginal costing also is useful in decisions involving potential changes in prices. This may be illustrated by assuming that our mythical company actually is selling 20,000 units of X at \$26.52 as budgeted. The

*Exhibit 17-7*

## Estimating the Effect of a Proposed Price Change under Marginal Costing

	<i>Present price</i>	<i>5% price reduction</i>	<i>10% price reduction</i>
Estimated unit volume .....	20,000	22,000	26,000
Unit price .....	\$26.52	\$25.19	\$23.87
Estimated revenue .....	\$530,400.00	\$554,180.00	\$620,620.00
Less: Marginal costs (\$14 per unit) .....	\$280,000.00	\$308,000.00	\$364,000.00
Marginal profit .....	\$250,400.00	\$246,180.00	\$256,620.00

sales department is considering the desirability of a reduction in the price of X. On the basis of a limited market survey, it is estimated that 5 and 10 percent price reductions would increase sales of X by 2,000 and 6,000, respectively. Exhibit 17-7 shows how marginal costing may be used in a decision of this type. It is apparent that a 10 percent price decrease will produce the greatest profit contribution.

An interesting example of the use of marginal costing by a large company appears in Exhibit 17-8. This company projects its costs 3 months in advance on the basis of past trends and a careful evaluation of the probability of cost changes. Several of the costs charged to product Z in Exhibit 17-8 are direct costs. Others are indirect. The latter are applied to products on the most logical basis available.

A special group in the controller's department prepares the data shown in Exhibit 17-8 and forwards them to pricing executives when significant cost changes occur. The pricing executive then reappraises the market

## Exhibit 17-8

A Company's Use of Marginal Costing  
Product Z

	Last quarter—actual		Next quarter—budget	
	Per cwt	Percent of sales	Per cwt	Percent of sales
Raw materials*	\$ 7.60	29.12%	\$ 7.74	28.89%
Packaging.....	2.51	9.62	2.51	9.36
Manufacturing labor†.....	2.33	8.93	2.45	9.14
Holidays, sick leave, vacations, etc.....	.55	2.14	.59	2.20
Factory repairs and maintenance.....	1.20‡	4.59	1.20	4.48
Other variable factory overhead, per cwt net.....	.25	.96	.25	.93
Variable delivery and warehousing, per cwt gross	1.60	6.13	1.60	5.97
Variable commissions and discounts, per sales dollar.....	2.61	10.00	2.68	10.00
Total variable costs.....	\$18.65	71.49	\$19.02	70.97
Selling price§.....	26.10	100.00	26.80	100.00
Contribution to fixed overhead and profit.....	\$ 7.45	28.51	\$ 7.78	29.03
Fixed costs:				
Factory, per cwt net.....	\$ 1.26		\$ 1.29	
Delivery and warehousing per cwt gross.....	1.46		1.48	
Other selling, per sales dollars.....	1.80		1.89	
Advertising, per sales dollars.....	.44		.46	
Total fixed costs.....	\$ 4.96	19.00	\$ 5.12	19.10
Net profit.....	\$ 2.49	9.51	\$ 2.66	9.93

\* Prices of raw materials expected to increase (as indicated).

† Wage rates expected to increase 5%.

‡ Based on the most recent 12-month period.

§ Price increased 70 cents per cwt.

¶ Increase in fixed costs results from an expected decline in volume during the next quarter.

situation in the light of these cost trends and, when expedient, modifies the product's selling price. The price revision need not be the same as the change in costs. The price of product Z was increased 70 cents per hundredweight, although variable costs are expected to increase only 37 cents. In short-run pricing situations, this company gives no consideration to increased fixed costs per unit as a consequence of temporarily operating at a below-normal level. An increase in unit fixed costs resulting from idle capacity rarely can be passed on to customers.

While accountants may argue about the merits of direct costing as a basis for measuring income, there can be no real argument about the usefulness of this approach in short-run pricing. A knowledge of marginal costs is indispensable to pricing executives (1) where excess capacity exists that cannot be absorbed by regular sales outlets, (2) where it is possible to increase the level of operations by selling products at reduced prices, generally to a different class of customers, and (3) where these additional sales at reduced prices do not endanger relations with regular customers.

While there are important advantages to be derived from the use of marginal costs as a guide to pricing, indiscriminate reliance upon this technique can be dangerous.

First, by concentrating their attention on the marginal contributions of each product, pricing executives may tend to disregard the necessity of recovering total costs including fixed charges. (In this connection, a survey conducted by the National Association of Accountants disclosed that companies interviewed which used direct costing were unanimous in their opinion that this had not occurred in their experience.<sup>1</sup>)

Second, special-order business accepted at below-normal price may subsequently develop into long-range production. The low-price pattern, having once been established, may become "sticky" and difficult to readjust.

Third, most manufacturing companies establish product prices in advance of production. Prices tend to become somewhat rigid and frequently prevail for long periods of time. It is doubtful whether under such market conditions many manufacturers can afford to indulge regularly in a completely marginal pricing program which gives effect to volume in each sales negotiation. Fear of competitor's reactions to price cuts is another powerful impediment toward the unrestrained use of a marginal pricing program. Most companies are reluctant to take pricing action which may endanger the stability of their market.

Fourth, in actual practice, the marginal ratio does not remain completely constant at different levels of output. Changes in selling prices and fluctuations in costs will affect this ratio. Cost patterns cannot always be precisely predicted, particularly semivariable costs, which for ease of computation are frequently classified as either variable or fixed. Certain

<sup>1</sup> See National Association of Accountants, Committee on Research, "Direct Costing," *NACA Bulletin*, April, 1953, p. 110.

variable costs do not vary in the same manner with decreases in output as they do with increases in output.

For example, management may be more reluctant to discharge workers than to employ additional workers. In addition, as output declines, new costs such as severance pay will appear. These changing factors do not necessarily mitigate the usefulness of marginal costing, provided executives are aware of the limitations involved. Indeed, an important benefit to be derived from marginal costing is that it permits management to trace the very effects of changing costs and prices on profits.

### Return-on-investment pricing

In computing selling prices under each of the cost methods previously discussed, no consideration has been given to the capital investment required to produce, finance, and distribute products or product lines. Yet, return on investment is the ultimate gauge of business efficiency. The inclusion of a factor in selling prices which gives effect to capital employed is of particular importance in multiproduct firms where varying capital investments are required for different products or product lines.

Under the full-cost method, our two products show an identical return on sales (23.1 percent, Exhibit 17-3). It would seem that they are equally profitable. However, when we give consideration to the capital investment required, as shown in Exhibit 17-9, product Y actually is a more profitable product in the long run, since it yields an expected return on investment of 21.6 percent as compared with only 13.6 percent for product X.

Return on investment also may be computed by multiplying the return on sales for each product by its capital turnover ratio, as shown below:

Return on sales $\times$ capital turnover = return on investment	
For product X	$23.1\% \times .589 = 13.6\%$
For product Y	$23.1\% \times .936 = 21.6\%$

Segregating these elements of return on investment facilitates analysis. Although both products are expected to earn the same rate of return on

### Exhibit 17-9

Comparison of Return-on-sales and Return-on-investment Methods

	Product X		Product Y	
Budgeted sales.....	20,000 @ \$26.52	\$530,400	30,000 @ \$32.76	\$982,800
Budgeted costs.....	20,000 @ \$20.40	\$408,000	30,000 @ \$25.20	\$756,000
Budgeted profit.....	20,000 @ \$6.12	\$122,400	30,000 @ \$7.56	\$226,800
Average annual capital required.....		\$900,000		\$1,050,000
Pretax return on sales..	$\$122,400 \div \$530,400$	23.1%	$\$226,800 \div \$982,800$	23.1%
Pretax return on capital	$\$122,400 \div \$900,000$	13.6%	$\$226,800 \div \$1,050,000$	21.6%



sales, product Y will yield a substantially higher return on investment, because its capital turns over 1.6 times as rapidly as that of product X.

The return-on-investment method may be used for setting prices for new products, where no market price exists; for determining the desirability of producing a new item where there already is an existing market price; for make or buy decisions; and for adjusting selling prices for cost fluctuations. The formula for establishing a sales price which will yield a desired return on investment is

$$P = \frac{(C + RFc)/U}{1 - RVc}$$

where  $P$  = selling price

$C$  = total cost of units to be sold

$R$  = desired return on investment

$Fc$  = fixed capital investment

$Vc$  = variable capital investment, as percent of sales

$U$  = units to be sold

The application of this formula may be illustrated by assuming that the unit cost of product Y has risen 10 percent, from \$25.20 to \$27.72, and that the company desires to increase the selling price of this product by an amount which will continue to yield the same return on investment (21.6 percent). Of the total capital investment required for product Y, the variable portion amounts to 39.17 percent of sales and the fixed portion to \$665,000. It is estimated that the number of units sold will not change as a result of the price rise.

$$P = \frac{[(27.72 \times 30,000) + (.216 \times 665,000)]/30,000}{1 - (.216 \times .3917)} = 35.51$$

*Proof:*

Sales (30,000 × \$35.51).....	\$1,065,300
Costs (30,000 × \$27.72).....	831,600
Profit.....	\$ 233,700
Capital investment [\$665,000 + (.3917 × 1,065,300)]	\$1,082,278
Return on capital.....	21.6%

### Flexible-cost data and pricing

We have examined the cost methods most commonly used in pricing decisions. These methods need not be regarded as mutually exclusive. In fact, the most effective system is one which can combine the essential features of each of these methods. This would provide pricing executives with flexible cost data that can be used to solve different pricing problems as they arise. An example of flexible cost data, which can be used in pricing and other management decisions, appears in Exhibit 17-10.

The marginal ratio shown in Exhibit 17-10 (line 5), is useful in short-run pricing decisions. It will be noted that cost center 2 is operating substantially below capacity. Consideration should be given to seeking



Exhibit 17-10

The Use of Flexible Costs for Product Pricing

Line		Cost center 1			Cost center 2		
		Product A	Product B	Total	Product C	Product D	Total
1	Net sales.....	\$6,800,000	\$680,000	\$7,480,000	\$3,250,000	\$1,625,000	\$4,875,000
2	Percent of total sales in cost center.....	90.9	9.1	100.0	66.7	33.3	100.0
3	Percent of total plant sales.....	55.1	5.5	60.6	26.3	13.1	39.4
4	Marginal contribution.....	\$3,128,000	\$346,800	\$3,474,800	\$1,368,300	\$721,500	\$2,089,800
5	Marginal ratio ( $4 \div 1$ ).....	46.0	51.0	46.4	42.1	44.4	42.9
6	Direct fixed costs.....	\$700,000	\$60,000	\$760,000	\$200,000	\$150,000	\$350,000
7	Profit before allocated fixed costs ( $4 - 6$ ).....	\$2,428,000	\$286,800	\$2,714,800	\$1,168,300	\$571,500	\$1,739,800
8	Percent profit before allocated fixed costs ( $7 \div 1$ ).....	35.7	42.2	36.3	35.9	35.2	35.7
9	Allocated fixed costs.....	\$1,100,000	\$110,000	\$1,210,000	\$850,000	\$310,000	\$1,160,000
10	Pretax net profit ( $7 - 9$ ).....	\$1,328,000	\$176,800	\$1,504,800	\$318,300	\$261,500	\$579,800
11	Percent pretax net profit ( $10 \div 1$ ).....	19.5	26.0	20.1	9.8	16.1	11.9
12	Direct capital used (direct fixed assets, receivables, inventory).....	\$2,700,000	\$380,000	\$3,080,000	\$1,200,000	\$430,000	\$1,630,000
13	Direct-capital turnover ( $1 \div 12$ ).....	2.52	1.79	2.42	2.71	3.78	2.99
14	Return of profit before allocated fixed costs on direct capital ( $7 - 12$ ).....	89.9	75.5	88.1	97.4	132.9	106.8
15	Indirect capital.....			\$2,800,000			\$1,800,000
16	Total capital investment ( $12 + 15$ ).....			\$5,880,000			\$3,430,000
17	Total pretax return on total capital ( $10 \div 16$ ).....			25.6			16.9
18	Total capital turnover ( $1 \div 16$ ).....			1.27			1.42
19	Cost center percent of capacity (2 shifts).....			85.0			60.0

new outlets for products C and D or even lowering the price to regular customers, if the demand for these products is elastic. Line 11, which discloses the return on sales, is identical with, and would have the same pricing applications as, the full-cost method. Line 14, "Return of profit before allocated fixed costs on direct capital," is significant in long-run product evaluation and pricing decisions. The exclusion of both allocated fixed costs and allocated capital results in a more precise reflection of a product's long-run profitability.

In Exhibit 17-10, product B, which has the highest marginal ratio (line 5) and percent of return before allocated fixed costs (line 8), has the lowest return of profit before allocated fixed costs on direct capital (line 14). This is due to the low capital turnover (line 13). The company should explore possibilities for improving the capital turnover of this product.

### The learning curve in cost estimating

Among companies that manufacture large and costly items, such as air frames, turbines, and boilers, prices generally are established on the basis of negotiation. This is because each item or batch of items is made according to customer specifications and unit costs vary with the quantity produced.

In order to provide customers with price quotations, it is necessary to estimate costs in advance of production. This may be done by preparing a detailed bill of materials, estimating labor costs by operation, and applying a factory-overhead rate or rates. Past experience with similar items provides an important point of reference. Unfortunately, this procedure is not always satisfactory. First, the time and cost of cost estimating may be excessive, particularly when a large percentage of the quotations may not develop into firm orders and the cost estimating effort may prove fruitless. Second, unit costs tend to decline as the size of an order increases. This occurs because laborers develop more skill as they repeat operations and because start-up costs can be amortized over a larger quantity of production. Cost estimators long have sought a technique that would speed up the estimating procedure and also give effect to the size of the order on unit costs.

During the past twenty-five years, a new and valuable tool has been developed which is called a *learning curve*, or *improvement curve*. The learning curve originated in the air frame industry but since has spread to other industries. Its greatest applicability is in industries that produce costly specialized equipment in which assembly labor represents a major element of cost.

The learning curve is based on the principle that as the quantity produced doubles, the cumulative average unit cost declines at a constant rate. The percentage decline in unit costs varies from industry to industry and is essentially dependent on the relationship between assembly labor hours and machine hours. In general, the higher the ratio of assembly labor to total cost, the greater the decline in unit costs will be with

*Exhibit 17-11*

## Illustration of an 80 Percent Learning Curve

<i>Production, in units</i>	<i>Cumulative average hr per unit</i>	<i>Percent of previous cumulative average</i>
1	200.0	—0—
2	160.0	80
4	128.0	80
8	102.4	80
16	81.9	80
32	65.5	80
64	52.4	80

increases in quantity. The air frame industry has experienced an 80 percent learning curve. This means that as the production of an item doubles, the cumulative average production hours per unit for successive batches will be 80 percent of the preceding batch. This is illustrated in Exhibit 17-11 and Fig. 17-1. It will be noted in Fig. 17-1 that the decline in cumulative unit costs is sharp at first and then levels out. As quantities rise, the increased efficiency from learning naturally tapers off.

Let us now assume that a company with an 80 percent learning curve receives an order for 40 units of  $X_2$ . It is estimated that the labor operations are essentially the same as item  $X_1$ , of which 10 units were recently produced, but that material costs will be 20 percent higher per unit. In quoting prices, the company adds 25 percent to factory costs to cover selling and administrative expenses and profit. The price quoted for a

Cumulative hours per unit

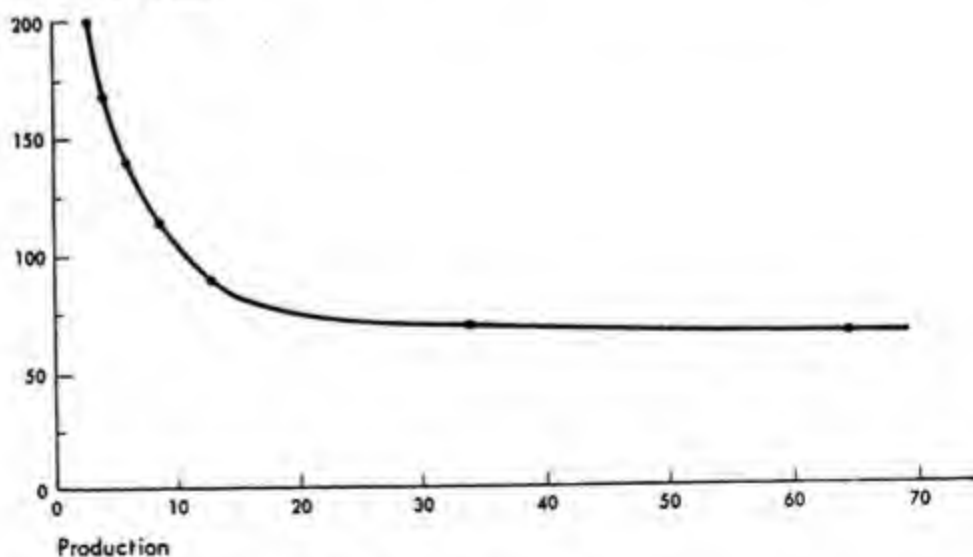


Fig. 17-1 An 80 percent learning curve.

*Exhibit 17-12*

## Application of an 80 Percent Learning Curve in Pricing

<i>Item</i>	<i>Production</i>	<i>Materials cost per unit</i>	<i>Labor and overhead cost per unit</i>	<i>Total factory cost per unit</i>	<i>25% for selling and administrative expenses and profit</i>	<i>Quoted selling price per unit</i>
X <sub>1</sub>	10	\$8,000	\$20,000	\$28,000	\$7,000	\$35,000
X <sub>2</sub>	10	9,600	20,000	29,600	7,400	37,000
X <sub>2</sub>	20	9,600	16,000	25,600	6,400	32,000
X <sub>2</sub>	40	9,600	12,800	22,400	5,600	28,000

unit of X<sub>2</sub> is calculated in Exhibit 17-12, a simplified presentation of a complicated subject. With the use of logarithm tables and the computer many advanced applications of the learning curve have been developed in such areas as pricing, scheduling production, and planning manpower requirements.

**Pricing in joint-product industries**

Product costs computed in a joint-product industry generally have little value as a guide to price setting. The allocation methods used to produce such costs, while justifiable for purposes of income determination, are too arbitrary to be useful for pricing.

On the contrary, it is quite common in joint-product industries to allocate total costs to individual products on the basis of their relative sales value. Selling prices thus act as a determinant of product cost instead of the reverse. Selling prices in such industries tend to be based on over-all company profit expectations, competition with similar or substitutable products, general market conditions, etc., rather than on their specific relationship to product costs.

The meat-packing industry represents a good example of a joint-product situation in which the cost-price relationship is inverted.<sup>8</sup> In this industry daily fluctuations in the market prices of cut meats take place. These price fluctuations are influenced primarily by the available supply of meat and the prices of competing products. With limited control over market prices, the meat packer uses the prevailing meat prices as a guide to determine what represents a profitable purchase price for livestock. This is accomplished by means of a daily "cutout" test.

The cutout test is designed to reveal the estimated profit that will be earned from a particular category of hogs, i.e., of a given weight range

<sup>8</sup> See A. D. Kaplan, Joel B. Dirlam, and Robert F. Lanzillotti, *Pricing in Big Business* (Washington, D.C.: The Brookings Institution, 1958), pp. 40-48.

*Exhibit 17-13*

Cutout Test  
Meat-packing Industry  
(180- to 220-lb-hog value)

	<i>Per cwt</i>
Current market value of finished cuts:	
Lean cuts.....	\$20.08
Fat cuts and lards.....	8.72
Ribs, trimming, etc.....	3.58
Total estimated market value of cut meats....	<u>\$32.38</u>
Less: Estimated costs	
Cost of hogs yesterday.....	\$20.51
Losses from condemned hogs.....	.11
Handling overhead.....	1.72
Processing costs.....	9.68
Total estimated cost of cut meats.....	<u>\$32.02</u>
Cutting margin based on yesterday's hog prices...	<u>\$ .36</u>

and quality. A predetermined hog yield in terms of finished meats, when multiplied by the prevailing market price of meats, provides an indication of the revenue that can be anticipated. From this is deducted the average cost of hogs for the preceding day plus the estimated processing and handling charges. With the resultant profit or loss as a basis, hog buyers are immediately advised to raise or lower their hog quotations for the current day's purchases. This type of calculation is illustrated in Exhibit 17-13.

The petroleum-refining industry is also confronted with the problem of joint-production costing. Although gasoline generally accounts for over 50 percent of the total revenue of an American oil refinery, sales of kerosene, fuel oil, residential heating oil, lubricating oils, liquefied gases, and other products derived from crude oil also are substantial. Each of these products is sold in markets which are sufficiently different as to require separate pricing policies.

In a reply to a survey made by the Brookings Institution, the Esso Standard Oil Company (New Jersey) stated: "A good many years of experience have demonstrated to us that the only practical way to establish a realistic refinery billing price is to follow the market closely and set our refinery billing price in line with the lower level of current market prices. . . ."

### Price differentials

The granting of discounts or other concessions to customers is an important aspect of pricing. Rare is the firm that does not indulge in at

<sup>9</sup> Ibid., p. 82.



least some form of price differentiation. Price differentials are based on the assumption that customers can be divided into classes and that the cost of serving each class varies. Differentials may be incorporated into the price structure of a firm through discounts or penalties based upon the size of orders, method of delivery, timing of sales, speed of collection, or distance from the point of shipment. In addition to a formal system of discounts, price differentials may be granted in the form of co-operative advertising allowances, installation and repair services, return and trade-in policies, rebates, etc.

Price differentials often are based on industry practices; if so, the firm has no discretion regarding their establishment. When a company is in the position to establish price differentials independently, cost analysis is most useful. In fact, conformance with the Robinson-Patman Act requires that the granting of volume discounts, for like items shipped interstate, be supported by provable cost savings. If price differentials are based on cost data, it is necessary, by measuring classes of revenue, e.g., according to size of order, to segregate those costs that are relevant and eliminable.

An illustration of the use of costs in establishing price differentials appears in Exhibit 17-14. A portion of City Stores' sales are in the form of house deliveries. Customers have been charged 40 cents per order for this service regardless of the distance from the store. Management has decided to establish a price differential based on the actual cost of deliveries to each of the sales districts. The eliminable delivery costs relevant to each district are shown in Exhibit 17-14. Some of these costs can

#### Exhibit 17-14

##### CITY STORES, INC. Calculation of Price Differentials on Home Deliveries

<i>Delivery costs</i>	<i>Basis</i>	<i>Central city</i>	<i>City districts 1, 2, and 3</i>	<i>Suburbs</i>
Drivers salaries and fringe benefits...	Actual	\$24,600.00	\$62,000.00	\$14,000.00
Truck depreciation.....	Actual	6,000.00	15,000.00	3,000.00
Gas and oil.....	Actual	2,600.00	5,600.00	900.00
Garage and maintenance.....	Number of trucks	2,000.00	5,000.00	1,000.00
Insurance and taxes.....	Number of trucks	800.00	2,000.00	400.00
Licenses, tolls, etc.....	Number of trucks	600.00	1,500.00	300.00
Cost of money.....	10% book value of trucks	1,200.00	3,000.00	600.00
<b>Total.....</b>		<b>\$37,800.00</b>	<b>\$94,100.00</b>	<b>\$20,200.00</b>
Number of orders delivered.....		100,000	180,000	25,000
Price differential per order per district (rounded).....		\$ .38	\$ .52	\$ .81

be directly identified with a district; others must be allocated on the most logical basis available.

### **Mathematical models and pricing uncertainty**

Effective pricing decisions largely depend upon marginal analysis. While the marginal cost function generally can be closely approximated in practice, it is virtually impossible to quantify marginal revenue with real precision. Calculating the revenue function involves the measurement of a host of interacting variables, including elasticity of demand, reactions of competitors to price changes, economic conditions, availability of substitutes, consumer knowledge, and the extent of promotional effort.

In recent years, some mathematicians and economists have attempted to deal with these uncertainties by constructing probability models. An essential feature of these models is reliance on subjective valuations of future probabilities by executives. The combination of objective data, e.g., costs, together with the manager's subjective valuations can be expressed mathematically and an optimum profit path obtained. It is still too early to evaluate the impact of mathematics on pricing and other decision-making areas. While these models are still largely dependent on subjective evaluations of the probabilities involved, they at least represent a disciplined approach to the measurement of uncertainty. Mathematical models, together with the computer, also offer hope of isolating some of the hitherto unmeasurable variables.

### **Problems and cases**

- 17-1 *Relevant costs for pricing decisions.* In what ways may costs used in pricing decisions differ from accounting costs?
- 17-2 *The full-cost method.* What are the advantages and disadvantages of the full-cost method of pricing?
- 17-3 *The marginal-cost method.* What are the advantages and disadvantages of the marginal-cost method?
- 17-4 *Learning curves.* In what type of pricing situation may a learning curve have importance?
- 17-5 *Joint costs and pricing.* In a joint cost situation, do the product costs have relevance in setting prices?
- 17-6 *Inverse cost-price relationships.* How can prices determine costs, instead of the reverse?
- 17-7 *Elasticity and shifts in demand.* What is the importance of elasticity and shifts in demand in pricing?

- 17-8 *Nature of competition and use of costs in pricing.* In general, indicate how the nature of competition affects the use of costs in pricing.
- 17-9 *Costs and price differentials.* How are costs used in setting price differentials?
- 17-10 *Pricing policies and the use of costs.* Show how pricing policies may differ among companies.
- 17-11 *Multiple products.* Are individual product prices and the use of costs affected when a company manufactures multiple products?
- 17-12 *Short- and long-run pricing.* Suppose that an order is taken on the basis of short-run pricing; may this have any long-run effects?
- 17-13 *Other considerations in pricing.* Indicate how each of the following affects pricing:
- Nature of competition
  - Level of operations
  - Financial condition
  - Product maturity
  - Price differentials
- 17-14 *Overhead rates and pricing.* In what ways does the level of activity at which overhead rates are set influence pricing? Is it possible that different levels of capacity for setting overhead rates may be justified for different purposes?
- 17-15 *Variances from standard and pricing.* If a company uses a standard cost system, should variances from standard have any influence on prices of products?
- 17-16 *Costs and different types of pricing situations.* Costs which may be relevant in some pricing decisions may not be relevant in others. How can the cost accountant cope with this problem?
- 17-17 *Computing selling price with changing costs.* In June, 1963, the Hot and Cold Co. sold 50 air-conditioning units for \$200 each. Costs included materials costs of \$50 a unit and direct-labor costs of \$30 a unit. Overhead was computed at 100 percent of direct-labor cost. Interest expense on a 4 percent bank loan was equivalent to \$1 a unit. Federal income tax at a 30 percent rate was equivalent to \$15 a unit.
- Effective July 1, 1963, materials costs decreased 5 percent, and direct-labor costs increased 20 percent. Also effective July 1, 1963, the interest rate on the bank loan increased from 4 percent to 5 percent per annum.
1. Assuming no change in the rate of overhead in relation to direct-labor costs, compute the sales price per unit that will produce the same ratio of gross profit.
  2. Assuming that \$10 of the overhead consists of fixed costs, compute the sales price per unit that will produce the same ratio of gross profit.

(AICPA)

- 17-18 *Computing price with changing costs.* From the following data you are to compute the unit sales price (adjusted to the nearest full cent) at which the

Howle Manufacturing Corporation must sell its only product in 1963 in order to earn a budgeted profit (before income taxes) of \$60,000.

The corporation's condensed income statement for 1962 follows:

Sales (30,000 units).....	\$450,000
Returns, allowances, and discounts.....	13,500
Net sales.....	\$436,500
Cost of goods sold.....	306,000
Gross profit.....	\$130,500
Selling expenses.....	\$60,000
Administrative expenses.....	30,000
Net profit (before income taxes).....	<u>\$ 40,500</u>

The budget committee has estimated the following changes in income and costs for 1963:

- 30% increase in number of units sold.
- 20% increase in materials unit cost.
- 15% increase in direct-labor cost per unit.
- 10% increase in production overhead cost per unit.
- 14% increase in selling expenses, arising from increased volume as well as from a higher price level.
- 7% increase in administrative expenses, reflecting anticipated higher wage and supply price levels. Any changes in administrative expenses caused solely by increased sales volume are considered immaterial for the purpose of this budget.

As inventory quantities remain fairly constant, the committee considers that, for budget purposes, any change in inventory valuation can be ignored. The composition of the cost of a unit of finished product during 1962 for materials, direct labor, and production overhead, respectively, was in the ratio of 3 to 2 to 1. No changes in production methods or credit policies are contemplated for 1963.

(AICPA)

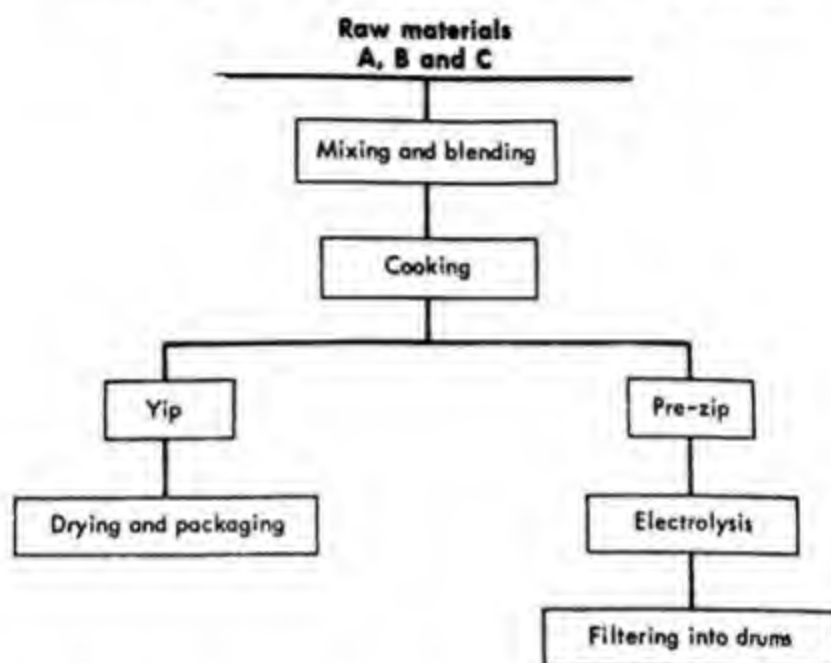
- 17-19** *Setting prices for new products in process type operation.* From the information below, prepare the following statements, supported by whatever explanatory exhibits you consider necessary:
1. Statement to show at what list price and at what net price per pound Yip should be sold
  2. Statement to show at what list price and at what net price per gallon Zip should be sold
  3. Condensed income statement to show, separately and combined, the results of operations in Yip and Zip, on the assumption that the entire quantity of each product manufactured will be sold at the respective prices indicated in the statements prepared in (1) and (2) and that selling, administrative, and general expenses are to be included at the same estimate as is allowed in setting such prices

Chemco, Inc., has perfected a process for producing from the three raw materials A, B, and C two chemical compounds Yip and Zip.

The raw materials are required in the following proportions by weight:

A.....	3 parts
B.....	5 parts
C.....	2 parts
	<u>10 parts</u>

The following diagram illustrates the manufacturing process:



One hundred thousand (100,000) pounds of raw material will be processed. The unit costs of the three raw materials are as follows:

A.....	\$ 2 per lb
B.....	50 per ton
C.....	4 per gal

Other costs of production are estimated to be:

Mixing, blending, and cooking.....	\$16,090
Additional costs applicable to Yip:	
Drying and packaging.....	4,660
Additional costs applicable to Zip:	
Electrolysis and filtering to drums.....	6,920

The cooking process reduces the weight of the combined raw materials by 40 percent.

Out of 100,000 pounds of original raw materials, 20,000 pounds of pre-Zip are obtained. Of the pre-Zip electrolyzed 25 percent becomes a nonmarketable precipitate, the remainder, a liquid, being filtered into 50-gallon drums without further attention.

The cost of drums, which are returnable and for which customers are to be charged specifically, is not to be included in either the cost or the price of Zip.



Each product is to be sold on the basis of a list price, less 35 percent and 10 percent. Of the net selling price of each product, 25 percent is to be allowed for selling, administrative, and general expenses (including provision for income tax) and 20 percent for net profit after provision for all costs and expenses.

The company has never marketed either of the products but has demonstrated the existence of markets for both if they can be manufactured to sell at suitable prices. Its experience in producing both these and other chemicals leads it to believe that the above estimates of cost relative to the processing of 100,000 pounds of the three raw materials combined are reliable as a basis for setting a price for each of the products to be manufactured therefrom.

Note: One gallon of Zip weighs 7.5 pounds. One gallon of raw material C weighs 8 pounds.

(AICPA)

- 17-20 *Cost estimating.* The Barlock Corporation manufactures ceramic, rubber, and metal sealers. It is the leading firm in the industry. Approximately 40,000 different products are manufactured. The majority of these products are made to customer specifications. As orders come in, they are referred to product-line managers, who do all the pricing. Prices range from \$4 to several thousand dollars per order. A large number of the orders are below \$10 in amount, but many of these come from customers who also submit larger orders from time to time.

The firm's policy requires that prices be based on standard costs, adjusted for recovery of selling and administrative expenses and a stipulated profit margin. In pricing, variances from standard are not considered.

A study undertaken by the controller's department indicates that it cost from \$8 to \$14 to estimate the cost of an order, depending on size and complexity. The sales department claims that about 20 percent of the orders are rush orders that are lost because of delays in quoting prices. What is your reaction to this situation?

- 17-21 *Return-on-sales full-cost pricing.* The Marina Company has been manufacturing and selling three products for many years. The company establishes prices by adding a 10 percent profit margin to the unit cost to make and sell each product. The plant is operating at close to full capacity. The following budgeted data are relevant for the forthcoming year.

	Product X	Product Y	Product Z
Budgeted unit sales.....	20,000	30,000	50,000
Variable costs per unit.....	\$23	\$36	\$28
Direct fixed costs.....	\$160,000	\$150,000	\$300,000
Indirect fixed costs (allocated on basis of units sold).....	\$180,000	\$270,000	\$450,000
Direct capital employed:			
Variable per unit.....	\$7	\$6	\$6.50
Fixed.....	\$220,000	\$200,000	\$320,000
Allocated capital (on basis of units sold)...	\$400,000	\$600,000	\$1,000,000

The president of the company has been concerned about the company's declining return on investment. He comments as follows to the controller: "Actually, the total number of units we are selling has not dropped, although two of our products have declined sharply during recent years. Fortunately, the slack has been taken up by another one. Since we are getting the same return per dollar of sales on each product, I shouldn't think it would affect our position." Following the company's procedure, what would the prices be for the coming year? What do you think about the president's comment?

**17-22** *Computing price quotation on a special job.* Bids have been asked on a proposed contract to be let January 1, 1963, for 200,000 units of gear assemblies to be supplied for the United States government. If successful, the contract probably will result in a long-term arrangement. You are requested to compute prices on behalf of the Foundry and Machine Company, based upon the following data:

Shipment of 100,000 units is required within the first 6 months (January-June) and a like quantity in the following 6 months.

The entire plant will necessarily be devoted to production under this contract, if received. The company's objective will be to earn a return (pretax) at the rate of 20 percent per annum on its capital and surplus as of the beginning of each year.

New machinery will immediately be required, costing \$60,000, which is to be written off over 1 year, regardless of whether or not the contract is renewed. Present facilities consist of buildings valued at \$75,000 and machinery and equipment with a gross book value of \$250,000, on which regular depreciation is to be computed at annual rates of 2 and 10 percent, respectively.

A maximum force of 400 men will be possible on direct production. Time required for the initial 100,000 units is to be estimated at 4 hours per unit, with an average direct-labor cost of \$8 (per unit). For each additional 100,000 units the direct labor will be more efficient, resulting in a saving of 10 percent in direct-labor cost. One-half of the saving in direct-labor cost from the original \$8 per unit is to be passed along as an incentive bonus to the workers directly employed on production. The company anticipates certain periods of plant inactivity during 1963, but not of such an extent as will interfere with the production of the quantities it undertakes to produce.

Of indirect labor, \$80,000 a year will remain constant, irrespective of production, and the balance will fluctuate in relation to direct-labor hours. The total indirect-labor cost currently runs \$30,000 per month, and this same cost, it is considered, will continue during the first 6-month period of 1963.

Materials cost from stock will remain constant at \$7 per unit. Scrap recovery will approximate 5 percent of materials cost. Production will be limited to the number of units completed for shipment during each period, no stock to be made ahead.

Machinery and equipment repairs are estimated to amount to 10 percent of the gross book cost of such equipment in 1963.

Insurance, taxes (other than income), and miscellaneous expenses are estimated as remaining fixed at \$100,000 per annum. Executive and administrative expenses will amount to \$10,000 per month.

Fifty percent of the net earnings is to be distributed in dividends as of December 31 each year, following past policy. The company's capital consists of 10,000 share of capital stock with a \$100 par value and the Retained

Earnings account as of January 1, 1962, stood at \$400,000. Net earnings for 1962 from the company's normal business will be \$80,000.

(Ohio CPA adapted)

17-23

*Marginal costs in pricing.* The Rheta Rose Manufacturing Company produces an item which it sells direct to consumers under its own brand. The item sells at \$12.50 per unit, which is a long-established price. Owing to a general decline in business activity, sales are currently being made at the rate of 5,000 units per month which is only 40 percent of the normal productive capacity of the plant of the company.

An analysis of the costs of the company for a recent month, during which only 4,000 units were produced and 5,000 units sold, shows the following:

Direct labor.....	\$ 9,900.00
Superintendent's salary.....	1,000.00
Assistant superintendent's salary.....	750.00
Power purchased.....	560.00
Direct materials.....	4,000.00
Purchased parts.....	2,400.00
Depreciation of building.....	1,420.00
Maintenance of building.....	206.00
Heat and light.....	348.00
Indirect labor.....	2,240.00
Miscellaneous supplies.....	800.00
Depreciation of machinery.....	3,640.00
Repairs to machinery.....	480.00
Property taxes.....	600.00
Insurance (fire).....	80.00
Social security taxes.....	456.00
Miscellaneous.....	1,120.00
	<u>\$30,000.00</u>

#### Selling Costs

Manager's salary.....	\$ 833.33
Salesmen's commissions.....	18,750.00
Travel.....	247.05
Advertising.....	500.00
Clerical salaries.....	300.00
Packing and shipping.....	2,108.43
Miscellaneous.....	1,203.79
	<u>\$23,942.60</u>

#### Administrative and General Costs

Officers' salaries.....	\$ 1,525.00
Office salaries.....	975.50
Telephone and telegraph.....	217.73
Supplies.....	486.21
Bad debts.....	625.00
Miscellaneous.....	392.86
	<u>\$ 4,222.30</u>

An offer has been received from a chain store organization by the treasurer of the company to purchase 5,000 units a month of the products with only immaterial modifications, to be shipped and billed to the individual stores. The items would be sold under the store's label and would be packed and shipped as directed by the chain at its expense. They offer \$7 per unit unpacked on the basis of a 1-year contract. The management of the Rheta Rose Company does not expect that there will be an improvement in the business within the next year, and there is no fear that the sale of the items to the chain would reduce the present volume of sales to consumers. The company does not believe it can afford to accept the order, as it is losing on its present price of \$12.50. Therefore, it appears that losses would be substantially increased by entering into the sales contract with the chain.

The treasurer calls you in to prepare an analysis which will show the result of accepting the order, in comparison with the result if the order is not accepted. In preparing your analysis you are to assume that all items of cost are either completely fixed or completely variable, depending upon the usual dominant characteristic of each item and the data given herein.

(AICPA)

- 17-24** *Pricing for return on investment.* The Sunset Company prices its products to yield a 20 percent pretax return on capital. A cost estimate has been prepared for a new product of which the marketing department estimates that the company can sell 20,000 units a year if the price is in the range of \$9.75 to \$10.25. The cost estimate indicates that the fixed costs applicable to this product will be \$60,000 and that the variable costs will be \$6 per unit, as shown below:

Estimated Variable Cost per Unit	
Materials .....	\$3.00
Direct labor (1 hr) .....	2.50
Other variable costs (\$.50 per hr) .....	.50
Total .....	\$6.00

The fixed capital required to manufacture and distribute this product is estimated at \$50,000 and the variable capital at 25 percent of sales.

*Required:*

1. On the basis of the foregoing data, what should the price be?
2. What implicit assumptions underlie the calculation that may make the problem somewhat more difficult in practice?
3. What will the return on capital be if the price is reduced 10 percent and 10,000 more units are sold?
4. Assume that after 6 months of operation at the price set in (1) the cost estimate is found to be faulty in the following respects: it takes only .8 hr to produce the product; raw materials prices are 10 percent higher than had been anticipated; variable capital amounts to only 20 percent of sales. What should the price be?



- 17-25 *Pricing to achieve a desired return on investment.* The income statement for the paperboard division of Old Ironsides Paper Company, for the first 6 months of 1963, is presented below in condensed form:

### OLD IRONSIDES PAPER COMPANY

#### Paperboard Division

January 1-June 30, 1963

	Amount	Feet	Per foot
Sales.....	\$1,000,000	400,000	\$2.50
Cost of sales.....	600,000		1.50
Gross profit.....	\$ 400,000		\$1.00
Less: Selling and administrative expenses.....	240,000		.60
Income before taxes.....	\$ 160,000		\$ .40
Variable capital (with sales).....	\$ 250,000		
Fixed capital.....	600,000		
Total.....	\$ 850,000		
Return on capital.....	18.8%		

During July, 1963, labor rates are increased and will add an additional \$60,000 a year to the cost of labor. As the company's cost accountant, you are requested to furnish the sales vice-president with a selling price that will permit the division to achieve a 25 percent return on capital, after giving consideration to the increase in labor cost. All products in the paperboard division have approximately the same markup. Units sold are expected to remain unchanged.

- 17-26 *Marginal-cost pricing.* The income statement for the Hynes Company, for the 6 months ended June 30, 1962, appears in Exhibit I.

The company maintains a standard cost system, inventories being costed at the current standards. Variances are transferred to Cost of Sales during the month incurred. During the 6-month period, 9,500 units of the company's single product were finished and transferred to the finished-goods stock room. The factory is expected to operate at its present level during the next 6 months.

The labor rate variance is due to an hourly rate increase which became effective on March 31, 1962. Throughout the 6-month period, labor operated at about the same level of efficiency, and the same number of laborers were employed.

Approximately 80 percent of the raw materials used is represented by one item, Alpha. The unfavorable price variance represents a rise in the price of Alpha which took place on February 1, 1962. From February 1 to June 30, \$50,000 worth of Alpha was purchased.

Mr. Pat Hynes, the president, is quite certain that he can obtain a 9,000-unit order from the Smart Shop chain, provided that he can grant a 15 percent discount. The order would be shipped at the rate of 1,500 units a month.

No other cost changes are anticipated during the next 6 months. Mr. Hynes wants you to advise him whether or not he can afford to grant the discount. No selling commission or other selling expenses would be incurred.



## Exhibit I

## THE HYNES COMPANY

## Income Statement

For the Six Months Ended June 30, 1962

Sales (8,930 units @ \$25)		\$223,250
Cost of sales:		
Work in process, Jan. 1, 1962	-0-	
Materials used	\$ 80,000	
Direct labor	42,000	
Variable overhead applied	20,000	
Fixed overhead applied	36,000	
	<u>\$178,000</u>	
Less: Work in process, June 30, 1962*	8,900	
Cost of goods manufactured	<u>\$169,100</u>	
Add: Finished goods, Jan. 1, 1962	20,000	
Cost of goods available for sale	<u>\$189,100</u>	
Less: Finished goods, June 30, 1962	25,009	
		<u>164,091</u>
Gross profit at standard		\$ 59,159
Less: Variances from standard		
Materials price	\$ 2,500	
Labor rate	1,050	
Labor efficiency	4,000	
Overhead volume	6,000	
		<u>13,550</u>
Gross profit—actual		\$ 45,609
Less: Selling and administrative expenses		
Variable selling		
Selling (6% of sales)	\$ 13,395	
Shipping (\$1.50 per unit)	13,395	
Total	<u>\$ 26,790</u>	
Fixed selling and administrative	14,002	
		<u>40,792</u>
Profit before income taxes		<u>\$ 4,817</u>

\* 1,000 units approximately half finished as to materials and conversion costs.

17-27 *Full-cost pricing.* Down John, Inc., a drug concern, manufactured three products in 1962, Calm Caps, Acheaway Lotion, and Coldkill Tablets. The company's management believes that its products are sufficiently differentiated to permit prices to be based on costs plus a reasonable profit. Accordingly, at the close of each year, the cost accountant prepares a statement summarizing the actual cost of each product during the past year. These costs are then reviewed by management and adjusted for expected cost trends during the coming year. A profit margin of 10 percent of the cost to make and sell each item is then added, and the total represents the announced selling price for the coming year.

The company maintains a research center where costs are accumulated in two categories, product and general research. Product research costs relate to specific product development projects. If the project is abandoned, the product research costs are added to general research and allocated to all products

## Exhibit I

DOWN JOHN, INC.  
1962 Product Cost Statement

	<i>Calm Caps</i> (per box)	<i>Acheaway</i> <i>Lotion</i> (per bottle)	<i>Coldkill</i> <i>Tablets</i> (per box)
Ingredients.....	\$ .342	\$ .286	\$ .330
Bottles and boxes.....	.001	.009	.003
Direct labor.....	.200	.120	.100
Fringe benefits.....	.030	.018	.015
Variable overhead—direct.....	.041	.009	.012
Variable overhead—allocated.....	.050	.030	.025
Fixed overhead—direct.....	.095	.010	.040
Fixed overhead—allocated.....	.200	.120	.100
Cost to make.....	\$ .959	\$ .602	\$ .625
Selling and administrative expenses— direct.....	\$ .104	\$ .041	\$ .047
Selling and administrative expenses— allocated.....	.059	.036	.038
Product research.....	.040	—0—	—0—
General research.....	.098	.060	.063
Cost to make and sell.....	<u>\$1.260</u>	<u>\$ .739</u>	<u>\$ .773</u>
Units sold—1962.....	800,000	10,000,000	18,000,000

currently being sold. If the project results in a marketable product, the costs are written off over the first 3 years' expected sales.

The cost accountant's product cost data for the three items sold in 1962 are presented in Exhibit I.

Allocated variable and fixed overhead costs are applied to products on the basis of direct labor. Allocated selling and administrative expenses and general research are prorated on the basis of total cost to make.

Except for the following, costs and sales are expected to be about the same in 1963 as in 1962:

1. Labor rates are expected to rise 6 percent.
2. Calm Caps were introduced in 1962. During that year, it took on the average .8 hour to produce a box, at an average hourly rate for direct labor of \$2.50. Labor efficiency is expected to improve by 10 percent in 1963.
3. The purchasing department has received a notice that bottle prices would be 10 percent higher in 1963.
4. Units sold of Acheaway Lotion are expected to be 5 percent less in 1963, whereas units sold of Calm Caps are expected to rise 10 percent in 1963.

A new product, Liver Up, is to be introduced in January, 1963. Sales of 500,000 boxes are anticipated in 1963, 800,000 in 1964, and 1,000,000 in 1965. One hundred thousand pounds of a single raw material will be required to meet the expected 1963 sales. Fifty thousand pounds of this raw material is on hand, having been left over from a previously made product and written down in inventory to \$25,000. The additional 50,000 pounds required will

cost \$50,000. Liver Up will be produced on the same machinery as Calm Caps and will use the same type of box. Direct labor is estimated at \$200 per thousand boxes. Direct variable overhead is expected to amount to \$25,000 a year. Product research for Liver Up totaled \$100,000. Direct advertising is expected to amount to \$40,000 a year, sales commissions to 10 percent a box, and miscellaneous direct selling and administrative costs to 4 cents per box.

*Required:*

1. Compute the 1963 product prices on the basis of the company's pricing policy. Inventories at the beginning and end of the year are to be ignored.
2. Evaluate the pricing system.

**17-28** *Evaluation of pricing policy.* The Bellavista Frame Company manufactures two products, Plasticframe and Metalframe. The following conversation took place at a meeting of top management, shortly after the close of 1963.

**KEN** (Sales Manager): "I am both disturbed and mystified. At the end of the first half of 1963, we showed a profit of \$19,748 and a return on capital of 11.3 percent. Yet, with slightly higher sales during the second half, our profit and return on capital declined about 30 percent (Exhibit I)."

**DICK** (President): "I've been puzzled about the same thing, particularly since our costs didn't change during the second half. Could it be due to the fact that the sales of Plasticframe declined so sharply?"

**KEN**: "Hardly, if you look at this product cost statement that Art prepared to help me in pricing you can see that both products are earning the same number of cents per dollar of sales (Exhibit II). Since the increase in Metalframe sales during the second half more than compensated for the drop in Plasticframe sales, our profits should have gone up slightly."

**DICK**: "You're right. Art, your figures are mighty strange."

**ART** (Plant Accountant): "I'll check them again, but as far as I know, they are correct."

**DICK**: "It's a good thing we had that excess capacity for Metalframe. Sales should continue next year at about the same level as the second half of 1963. What's so terribly disturbing is the decline in Plasticframe. Ken, what's causing this, and what can we do about it?"

**KEN**: "As far as I can see we're really up against an impossible situation. Foreign imports of plastic frames have risen substantially this year. They are priced 10 percent below us. I discussed the matter with our distributors, and we all agreed that we could easily regain the sales of Plasticframe that we lost in the second half if we cut our Plasticframe price 10 percent. Unfortunately, this is impossible; we're only making 7 cents a frame. A 10 percent price reduction would mean that we would lose 5.4 cents a frame."

*Required:* Evaluate the discussion, and prepare an exhibit which will account for the profit decline during the second half of 1963. Prepare also a profit projection for 1964, based on a price reduction and no price reduction in Plasticframe. Assume that, in 1964, the sales of the two products will continue to be at the same level as the second half of 1963, if no price reduction in Plasticframe occurs, and that if a price reduction takes place Plasticframe

sales will return to the first half level. Assume also that, in 1964, the actual fixed costs will be equal to the amount budgeted in Exhibit II. Additional data are provided in Exhibits III and IV.

*Exhibit I*

**BELLAVISTA FRAME COMPANY**  
Condensed Income Statement  
January 1-June 30 and July 1-December 31, 1963

	<i>1st half</i>	<i>2d half</i>	<i>Entire year</i>
Sales—Plasticframe.....	\$ 239,320	\$ 136,400	\$ 375,720
—Metalframe.....	160,022	265,016	425,038
Total.....	\$ 399,342	\$ 401,416	\$ 800,758
Cost of sales.....	291,557	298,355	589,912
Gross profit.....	\$ 107,785	\$ 103,061	\$ 210,846
Less: Selling and administrative expenses.....	88,037	89,273	177,310
Profit before income taxes.....	\$ 19,748	\$ 13,788	\$ 33,536
Capital investment.....	\$(175,100)*	\$(173,600)*	\$(348,700)
Return on capital.....	(11.3%)	(7.9%)	(9.6%)

\* The capital investment for 6 months has been halved so that the semiannual results will be comparable with the results for the entire year.

*Exhibit II*

**BELLAVISTA FRAME COMPANY**  
Product Cost Statement

	<i>Plasticframe</i>		<i>Metalframe</i>	
	<i>Amount</i>	<i>% to sales</i>	<i>Amount</i>	<i>% to sales</i>
Direct materials.....	\$ .360	29.0	\$1.200	35.6
Direct labor.....	.200	16.1	.500	14.8
Factory overhead (see note)...	.340	27.5	.750	22.2
Cost to make.....	\$ .900	72.6	\$2.450	72.6
Selling and administrative expense (30 % of cost to make).....	.270	21.8	.735	21.8
Cost to make and sell.....	\$1.170	94.4	\$3.185	94.4
Profit (6%).....	.070	5.6	.191	5.6
Price.....	\$1.240	100.0	\$3.376	100.0

*Note:* Factory overhead rates were established as follows:

	<i>Plasticframe</i>	<i>Metalframe</i>
Budgeted fixed factory overhead.....	\$ 96,000	\$ 44,650
Budgeted variable factory overhead.....	40,000	26,600
Total.....	\$136,000	\$71,250
Budget level (in units).....	400,000	95,000
Overhead rate (per unit).....	\$ .34	\$ .75

*Exhibit III*

## BELLAVISTA FRAME COMPANY

## Product Cost Statement

## On a Marginal-cost Basis

	<i>Plasticframe</i>	<i>Metalframe</i>
Selling price.....	<u>\$1.240</u>	<u>\$3.376</u>
Marginal costs:		
Raw materials.....	.360	1.200
Direct labor.....	.200	.500
Variable factory overhead.....	.100	.280
Variable selling and administrative.....	.120	.360
Total marginal costs.....	<u>\$ .780</u>	<u>\$2.340</u>
Contribution to fixed cost and profit.....	<u>\$ .460</u>	<u>\$1.036</u>
Less: Fixed costs directly applicable to products*		
Factory overhead.....	\$ .090	\$ .180
Selling and administrative.....	.010	.025
Total direct fixed costs.....	<u>\$ .100</u>	<u>\$ .205</u>
Contribution to indirect fixed costs and profit.....	<u>\$ .360</u>	<u>\$ .831</u>
Less: Indirect fixed costs*		
Factory overhead.....	\$ .150	\$ .290
Selling and administrative.....	.140	.350
Total indirect fixed costs.....	<u>\$ .290</u>	<u>\$ .640</u>
Profit.....	<u><u>\$ .07</u></u>	<u><u>\$ .191</u></u>

\* Based on budgeted annual sales of 400,000 units for Plasticframe and 95,000 units for Metalframe.

*Exhibit IV*

## BELLAVISTA FRAME COMPANY

## Capital Used by Products

	<i>Plasticframe</i>		<i>Metalframe</i>		
	<i>Fixed</i>	<i>Variable (% sales)</i>	<i>Fixed</i>	<i>Variable (% sales)</i>	<i>Total fixed</i>
Direct capital:					
Receivables.....	-0-	10.4	-0-	9.4	-0-
Inventories.....	\$10,000	12.1	\$ 8,000	11.3	\$ 18,000
Facilities.....	14,000	-0-	15,000	-0-	29,000
Total direct.....	<u>\$24,000</u>	<u>22.5</u>	<u>\$23,000</u>	<u>20.7</u>	<u>\$ 47,000</u>
Indirect capital.....					129,200
Total capital.....					<u><u>\$176,200</u></u>



## 18. **The Role of Costs in Capital-Investment Decisions**

Sound capital investments are important to the national economy as well as to the individual firm. The expansion of existing plant and equipment and the introduction of technological improvements represent major factors in economic growth and contribute substantially to increased productivity and a rising standard of living.

The problems involved in defining capital-investment policies and in selecting between investment possibilities are among the most difficult faced by business executives. Capital investments do not represent an isolated decision-making area. They involve a knowledge of production alternatives, market forecasting, product pricing, and financing.

The decision-making process is predicated upon estimates of the future. Property investments generally cannot be recovered in short periods of time. Once a company has appropriated funds for a particular investment, it has committed itself to a future path from which it can not easily deviate. Consequently, the elements of uncertainty and risk are particularly great in capital-investment decisions. These frequently induce business executives to rely on hunches or rules of thumb. In view of the vital nature of the decision, this is indefensible. An economically sound plan for capital investments, at the very least, establishes a procedure for arranging the available evidence in a logical pattern and for selecting the most desirable proposals.

Successful firms generally are faced with more potential investment projects than there are funds available for. Limited funds affect the procedure for approving projects. The firm is compelled to establish criteria for selecting between contending proposals.

### *Capital-investment projects*

The criteria used to evaluate the desirability of a proposed capital investment depends upon the nature of the expenditure. Four broad cate-

gories of investments will be used in this book: (1) nonprofit projects, (2) nonmeasurable-profit projects, (3) capital-replacement projects, and (4) expansion projects. Other categories are possible, as for example, cost reduction projects, product improvement projects, maintenance-of-earnings projects, and research and development. The categories used here are intended to be indicative rather than definitive.

### **Nonprofit projects**

Nonprofit projects involve expenditures arising out of legislative or contractual requirements which a company is obliged to make and for which profitability does not constitute the objective. Local ordinances may compel a company to institute a system of smoke control or to install safety devices for the protection of its workers. Since expenditures of this type are obligatory, the company has no need for establishing criteria for measuring the desirability of the outlays.

### **Nonmeasurable-profit projects**

Nonmeasurable-profit projects include investments which are designed to increase profits but for which the expected profits cannot be computed with any reasonable degree of accuracy. Included in this category are long-run expenditures for product promotion, research, and the improvement of workers' morale. It may be assumed that a firm interested in maximizing profits will not undertake investments of this type unless it is convinced that they ultimately will yield a profit. Unfortunately, it is virtually impossible to measure the marginal income of such expenditures. The additional revenue that may be derived from advertising or product development expenditures rarely can be calculated with sufficient accuracy to serve as a basis for justifying such outlays. The introduction of a low-cost employees' restaurant may reduce costs by improving the morale of workers, but the amount of the cost savings is not calculable.

Rough guides often are employed as the basis for determining the magnitude of investments of this type, such as a percentage of sales, a percentage of profits, corresponding expenditures of competitors, or the amount of available cash. None of these represents a satisfactory criterion, and they may actually produce misleading results. For example, basing advertising expenditures on a percentage of sales will result in a reduction in the advertising appropriation at the very time when advertising is needed to impede a decline in sales. In regard to capital investments in this category, the firm must rely primarily on the judgment of its managers rather than on quantitative data.

### **Replacement projects**

The replacement of existing capital assets essentially involves a problem of timing. The life of machinery and equipment can be prolonged al-

most indefinitely by means of continual repair and maintenance. However, the time will occur when the cost of operating the present asset will exceed the costs of a potential substitute. At this point, the existing asset has become obsolete. If the cost savings to be derived from the new asset will yield a satisfactory return on its capital investment, then replacement becomes economically desirable. Although cost savings generally represent the proper criterion for capital replacements, revenue too may have to be considered. This will take place whenever the productive capacity of the new asset exceeds that of the present one and a market exists for the additional units.

### **Expansion projects**

Expansion projects are designed to augment existing capacity. For capital investments of this type, it is desirable to estimate future profits and return on investment. It also is important to recognize a risk factor which varies with the nature of the project. The risk factor may be built into the formula used for evaluating capital proposals.

For example, one oil company requires a different minimum return on expansion investments in oil drilling operations, pipeline construction, and marketing. Generally, however, the risk involved in each capital proposal is evaluated by management at the time proposals are approved. Effect also should be given to the time value of money, since different investments do not yield cash flows in the same manner and dollars received at different future dates have different values.

### **Nonquantitative criteria**

In this chapter, the discussion will be concerned primarily with the use of quantitative data for determining the desirability of capital expenditures. Nonquantitative considerations also are important. Thus, relations with labor, maintenance of status and prestige within an industry, meeting competition, and compliance with state and municipal laws may represent the motives for a particular investment decision, regardless of the cost and revenue possibilities. Examples of such expenditures are recreation, dining, and other facilities for workers; introduction of machinery to match competitors' action; research and product development outlays; and expenditures related to the health and safety of workers.

### *Type of data required*

The type of costs required in capital-investment decisions differs from those reflected in the accounting records. Only future costs are relevant. Recorded costs may be useful but only to the extent that they furnish a starting point for future cost projections.

All estimated cash costs pertinent to the project under consideration

should be included in the study. Any expected savings in materials costs, particularly those arising from an expected reduction in scrap, should be reflected. Prospective changes in direct labor, materials handling, inspection, etc., should be recognized. Anticipated increases or decreases in specific overhead costs, such as taxes, insurance, power, maintenance, repairs, supplies, must be considered.

The use of a plant-overhead rate should be avoided. Frequently, the new equipment is more automatic than the old, and a different cost pattern will emerge. Payroll taxes, supervision, overtime premiums, and other overhead costs which vary with direct labor decline, and repairs, maintenance, power, and other costs which vary with machinery usage increase.

### Opportunity costs

Opportunity costs play an important role in capital-investment decisions. Opportunity costs represent the loss of alternative income as a consequence of action adopted. In an expansion project, the economic rather than book value of space required should be charged against a proposed investment. In a replacement decision, the *realizable* value of the existing asset should be treated as a reduction of the cost of the replacement.

### Interest cost

Accounting reports and statements typically give recognition to contractual interest but ignore imputed interest on capital. While the inclusion of interest is indispensable in investment studies, the determination of an appropriate rate presents difficulties. Interest sometimes is mistakenly considered as being the same as return on investment. Return on investment consists of two elements: interest and profit. The former represents the cost of money; the latter, a reward for risk and uncertainty. Interest cost constitutes the minimum acceptance criterion for capital-investment projects undertaken for profit. A firm must at least recover its money costs before it can realize a profit on its new investment. On the other hand, the minimum acceptance criterion that can be considered as a reward for risk and uncertainty varies with the nature of the risk assumed.

### Depreciation

Depreciation is another cost whose treatment in capital-investment analysis differs from other cost accounting reports and analyses. In studies designed to reveal the desirability of replacing existing machinery and equipment, depreciation of the unabsorbed book value of an existing asset is a sunk cost and is not relevant, *except* for its tax effect. It is only the *economic* value of an asset that has relevance in replacement decisions. The common error, except for tax savings, of including a loss



on the undepreciated book balance of the existing asset in the replacement analysis imposes an unjustified penalty on the prospective asset and injects an unwarranted element of conservatism into the replacement decision.

### Estimating the revenue from proposed capital investments

In capital-investment studies, differential revenue, where measurable, cannot be ignored. There are two facets to this problem: (1) the potentiality, or capacity, of the asset under consideration and (2) the marketability of the increased output.

The potential output of an asset is based on engineering estimates and generally can be determined without great difficulty. Estimating the marketability of the product is considerably more difficult. In some situations, where the demand for a company's product is expected to remain unsatisfied, the practical capacity of the prospective asset will be equivalent to the units sold. Generally, however, the determination of future revenue possibilities is more hazardous and involves a multitude of factors such as consumer reactions, economic conditions, and activities of competitors. Under such circumstances, and particularly if the proposed capital expenditure is substantial, a formal market survey may be warranted.

### Income taxes and capital investments

Federal and state income taxes result in cash expenditures. Since capital investments are based on cash flows, income taxes are an important element in the decision. While the undepreciated book balance of a displaced asset is a sunk cost, it does constitute a tax-deductible cost and to that extent is pertinent in replacement decisions. The *disposition* of the old asset also affects income taxes. If the displaced asset has been held for longer than six months and is sold for a gain, the company will be subject to a maximum capital gains tax of 25 percent. On the other hand, losses sustained on such transactions are first applied against capital gains, any excess being deductible in full from ordinary taxable income.

Income taxes have other effects on capital-investment decisions. The tax benefits derived from the rapid amortization of defense facilities, investment credit, and the use of accelerated depreciation methods influence investment policies. Income tax regulations also are a significant factor in sale and lease-back arrangements. The percentage depletion provisions of the Internal Revenue Code stimulate capital-expansion activities in the extractive industries. The privilege of being able to carry back and forward operating losses encourages capital expansion by reducing the risk involved.

The tax implications of capital-formation policies are considerable. The complexities of the tax laws and applicable court decisions empha-



size the need for skill in this area. It is desirable for a company to have its tax department or outside tax consultant participate in all major capital-investment decisions.

### *The cost of capital*

In selecting among potential investments, a firm should accept only those proposals whose expected return, at the very least, will exceed the cost of capital to the firm. As a very simple comparison, it would be uneconomical for an individual to borrow money for investment purposes if he could not invest these funds at a higher rate. The cost of capital constitutes the minimum acceptance criterion or cutoff rate of return on new investments. Capital projects with returns below the cutoff rate dilute stockholders' equity. Unfortunately, determining the cost of enterprise capital perhaps is the most complex and controversial area in finance. While it is beyond the scope of this book to explore each of the different theories on the cost of capital, the intent is to provide the reader with an awareness of the nature and importance of the problem.

Several conflicting theories exist in regard to the cost of capital.<sup>1</sup> The cost of capital may be viewed from the standpoint of the corporation as a borrower or a lender. A "borrowing rate" represents the cost to a corporation of funds obtained by it from creditors and stockholders. The "lending rate" is based on an opportunity cost concept. According to this theory, the corporation always has the possibility of investing funds internally or externally, e.g., in other corporations or government bonds. Accordingly, a corporation should only undertake new capital investments when the expected return will exceed that of an external investment with the same risk. While the borrowing rate changes with the equity-debt relationship, the lending rate is unaffected by the financial structure of a corporation.

In practice, it is extremely difficult to calculate lending rates because of an inability to find external investments with the same risk as those undertaken internally. This book essentially will adhere to the borrowing rate approach.

The borrowing rate may be calculated on an average or marginal basis. If an average method is used, it is assumed that new capital proposals cannot be identified with a specific source of funds but instead are derived from a kind of capital melting pot in which all the available funds are merged and lose their identity.

It also is possible to argue that new capital investments are financed out of the most recent funds acquired and that older funds are used to

<sup>1</sup> See Joel Dean, *Capital Budgeting* (New York: Columbia University Press, 1951); Friedrich Lutz and Vera Lutz, *The Theory of Investment of the Firm* (Princeton, N.J.: Princeton University Press, 1951); and Ezra Salomon, "Measuring a Company's Cost of Capital," *Journal of Business*, The University of Chicago School of Business, 1955.

maintain existing operations. This marginal approach may be criticized on the following grounds: First, funds used can rarely be identified with their source. Second, the cost of funds varies substantially according to source. Under the marginal method, the cutoff rate for new capital investments may fluctuate sharply from period to period, as the financial structure changes. This would be most undesirable from the standpoint of selecting proposals. Third, for reasons of financial stability, a corporation tends to maintain a certain equilibrium between its short- and long-term equity and debt capital. Thus, an imbalance during one period, arising out of a particular type of financing, tends to be counterbalanced in subsequent periods, in order to restore the desired financial equilibrium.

The cost of capital includes both interest and dividends. This does not conform to the accountants' usual definition of cost. Accountants regard dividends as a distribution of profits rather than a cost. However, from the standpoint of the corporation, as a separate entity, dividends represent the cost of the capital provided by its stockholders. In addition to interest and dividends, the cost of capital also includes underwriting fees, stamp taxes, registration, and other costs related to the issuance of a security.

A corporation may derive funds from the following principal sources: common stock, preferred stock, bonds, and reinvested earnings. Before examining the cost of these sources of capital more closely, it should be emphasized that the actual or legal rate on outstanding securities does not represent the true cost of the money provided. An opportunity cost concept also applies to the borrowing rate. A company may have a legal obligation to pay 4 percent interest on its outstanding bonds. However, the current market rate on equivalent bonds may be 5 percent. The latter rate represents the replacement cost of the funds provided from this source. If the corporation had no better capital-investment projects under consideration, it could at least invest these funds in equivalent securities at the 5 percent prevailing rate.

### Cost of funds provided by the sale of common stock

The cost of funds derived from the sale of common stock is reflected in the ratio between the market price and *expected* earnings per share. This may be demonstrated by assuming that a corporation is planning to issue additional stock to finance an expansion program. Unless the new project is able to earn at least as great a return per share as anticipated by the market, a dilution in the value of the stock will occur, with an economic loss to the stockholders. It should be emphasized that the price-earnings ratio contains *future* rather than *present* earnings per share.

Let us assume that two companies, having equally sound financial structure, have price-earnings ratios respectively of 20 to 1 and 10 to 1. This does not imply that stockholders of the first company are willing to

## Exhibit 18-1

Effect on Existing Common Stock Equities of a  
Reduced Return on New Common Stock

	<i>Earnings data relating to common stock outstanding as of Dec. 31, 1964</i>	<i>Actual earnings data relating to common stock issued on Jan. 1, 1965</i>	<i>Combined earnings data for the year 1965</i>
Number of shares.....	100,000	100,000	200,000
Total pretax earnings.....	\$800,000	\$600,000	\$1,400,000.00
Income tax (50 % rate assumed).....	\$400,000	\$300,000	\$700,000.00
Earnings after tax.....	\$400,000	\$300,000	\$700,000.00
Posttax earnings per share.....	\$4	\$3	\$3.50
Ratio of posttax earnings per share to market price per share.....	10 %		10 %
Market price per share.....	\$40		\$35.00
Total market value of shares outstanding.....	\$4,000,000		\$7,000,000.00

accept a 5 percent return on their investment, since they could invest their funds in the second company and earn 10 percent. Actually, the stockholders of the first company expect an even higher return than 10 percent to compensate for the present low rate. Unfortunately, it is not possible to specify precisely what the future earnings are that have been discounted in the current market price of the stock. For this reason, although theoretically incorrect, in the illustration that follows it will be assumed that the present, known rate of earnings per share is equal to the future, or expected, earnings per share. This assumption is commonly made in practice because of uncertainty as to future earnings.

Exhibit 18-1 shows how a dilution in present stockholders' investment occurs if new investments, financed out of common stock, earn less than the price-present earnings per share ratio. If the company were to issue an additional 100,000 shares of common stock on January 1, 1965, with actual earnings as shown, the market price of the stock would decline from \$40 to \$35. This occurs because the market would maintain the 10 to 1 ratio of price to earnings per share. The \$5 decline in the market price of a share would result in a \$500,000 loss to the present stockholders. Presumably a rational management would not deliberately plan to jeopardize the interests of the legal owners of the corporation in this manner. Accordingly, if the proposed expansion program could not yield at least a 10 percent return, it would be rejected, or the company would seek a less costly source of funds than common stock.

**Cost of funds derived from retained earnings**

Earnings which have been retained in the business represent additions to the stockholders' investment in the corporation. If these retained earnings are not reinvested by the corporation so as to yield a rate of return at least equal to that which is being earned on the capital provided by the common stock, a decline in the earnings on the stockholders total equity will occur. In Exhibit 18-2, it has been assumed that the money provided by the original sale of stock continues to earn 10 percent in the second year of operations but that the earnings reinvested in the business can produce a return of only 6 percent.

It is apparent that while the earnings per share have increased, the rate of return on the total stockholders' investment (including reinvested earnings) has declined. What is the economic effect of this on the stockholder? Presumably, if capital expenditures financed out of retained earnings cannot yield at least the same rate of return as that which is being earned by the funds originally provided by the stockholders, the latter would find it more desirable to withdraw the retained earnings in the form of dividends and invest them in another company which has the same risk but which will provide the 10 percent return desired.

The extent to which stockholders can withdraw earnings is largely dependent upon the degree of independence possessed by the corporate management in regard to the distribution of dividends. In large companies, those with several hundred thousand stockholders, management is generally able to function for long periods of time with considerable

**Exhibit 18-2**

**Effect on Common Stock Equity of Reinvesting Corporate Earnings  
at a Rate below Common Stock Earnings**

	<i>End of first year of operations</i>	<i>Earnings rate (after tax) during second year of operations</i>	<i>End of second year of operations</i>
Earnings after tax . . . . .	\$200,000	<div style="display: flex; align-items: center; justify-content: center;"> <div style="margin-right: 10px;"> <div style="display: flex; flex-direction: column; align-items: center;"> <div>6%</div> <div>10%</div> </div> <div style="font-size: 2em; margin: 0 10px;">}</div> <div style="font-size: 2em; margin: 0 10px;">↑</div> </div> </div>	\$206,000.00
Dividends (50 %) . . . . .	\$100,000		\$103,000.00
Reinvested earnings . . . . .	\$100,000		\$103,000.00
Common stock (10,000 shares) . . . . .	\$2,000,000		\$2,000,000.00
Stockholders' equity . . . . .	\$2,100,000		\$2,203,000.00
Earnings per share . . . . .	\$20		\$20.60
Percent earnings on stockholders' equity at beginning of year . . . . .	10%		9.8%



independence. A total distribution of reinvested earnings also would endanger the stockholders' original investment, since it would leave the corporation with no safety margin as a protection against unprofitable years.

The desirability of the stockholders' withdrawing retained earnings for investment elsewhere also is greatly affected by personal income tax rates. If retained earnings are paid out in the form of dividends, the stockholders will have to pay a tax on the receipt of the initial dividend and another tax on the dividends received from the company in which the funds were secondarily invested. If the average common stockholder in our illustration (Exhibit 18-2) were in the 30 percent tax bracket and had the possibility of earning a 10 percent return elsewhere on the retained earnings paid out as dividends, he would not benefit from the withdrawal as long as the corporation earned at least 7 percent on its capital investments financed out of reinvested earnings.

While no specific answer can be furnished as to the cost of funds provided for capital investments out of retained earnings, the effect of management independence in regard to dividend policies, the need to safeguard the original investment, and the effect of income taxes imposed on dividends would seem to indicate that the cost of capital obtained from retained earnings is well below that of the rate being earned on the common stock.

### Cost of funds provided by the sale of preferred stock

The holders of nonparticipating preferred stock are entitled to a stipulated annual return on their investment, provided the board of directors declares dividends. From the standpoint of determining the cost to the corporation of funds derived from this source, a regular annual distribution of dividends should be assumed. The cost of these funds is measured by the relationship between the dividend rate and the current market quotation of the security, less estimated issuance costs, as shown in Exhibit 18-3.

### Cost of funds provided by sale of bonds

Calculating the cost of funds derived from the prospective sale of bonds is somewhat similar to calculating that of preferred stocks. In addition to the stated interest rate, the security may be sold to the public at a discount or premium which represents an adjustment of the stated inter-

#### Exhibit 18-3

##### Calculation of Cost of Funds Provided by Preferred Stock

Current market price per share.....	\$101.5
Less: Underwriting and other issuance costs per share.....	2.6
Net proceeds to company at current market.....	\$ 98.9
Stated dividends per share.....	\$ 5.0
Annual cost as a percentage of proceeds (\$5.0/\$98.9).....	5.05%



**Exhibit 18-4****Calculation of Cost of Funds Provided by Bonds**

Estimated market price.....		\$1000.00
Less: Underwriting and other issuance:		
Costs per bond.....	\$ 7.25	
Bond discount.....	15.00	22.25
Net proceeds to company.....		\$ 977.75

Annual cost of funds

$$= \frac{\text{interest} + \text{amortization of bond issuance costs and discount}}{\text{net proceeds}}$$

$$= \frac{\$40 + (.10 \times \$22.25)}{\$977.75} = 4.32\% \text{ before tax, or } 2.16\% \text{ after tax}$$

est rate to the market rate at time of issuance. Assuming that an interest rate of 4 percent can be predicted and giving consideration to the expected issuance costs and bond discount, the calculation of the annual cost of a \$1,000-denomination 10-year bond appears in Exhibit 18-4.

Since bond interest costs represent a tax deduction, the actual cost of funds from this source in the above illustration is 2.16 percent. The foregoing method of calculation generally will provide sufficiently accurate results. However, it does not give consideration to the time value of money. The bond issuance costs are incurred immediately, whereas the bond discount is not paid until the maturity date. If a more precise calculation is required, bond interest tables may be employed.

**Calculating the average cost of capital**

Exhibit 18-5 shows how the average cost of capital, using the borrowing approach, might be calculated for the coming year. The method used

**Exhibit 18-5****Determination of the Approximate Average Cost of Capital**

<i>After-tax rate for calculating cost of capital, %</i>	<i>Source of long-term capital available</i>	<i>Amount of available capital</i>	<i>Cost of available capital</i>
10.0%	Common stock	\$180,000,000	\$18,000,000
6.0	Reinvested earnings	40,000,000	2,400,000
5.0	Preferred stock	50,000,000	2,500,000
2.1	Sinking fund debentures	20,000,000	420,000
2.2	Notes payable to banks to be contracted during coming year	20,000,000	440,000
Total.....		\$310,000,000	\$23,760,000
Average cost of capital			7.7%

conforms to the views expressed in the preceding pages. The cost of funds obtained from reinvested earnings was arbitrarily established at 60 percent of that for common stock.

### Determining the cutoff rate

The average cost of capital frequently is construed as representing the minimum acceptable rate of return, or cutoff rate, for new investments. This is a mistaken notion. It will be recalled that we have classified our new capital investments in four categories. In regard to the first two of these categories, nonprofit projects and nonmeasurable-profit projects, the return on investment cannot be computed and must therefore be considered as being equal to zero.

Replacement projects are somewhat different from expansion investments. They represent a course of action to which the company is already committed. The present asset generally cannot be dispensed without affecting an existing production pattern. This asset presumably also is part of a scheme which already is producing a profit. The element of risk in replacement investments thus is considerably less than in expansion investments. In replacement projects, the choice facing the company is essentially one of timing. When the operating superiority of the new asset will result in a cost saving sufficient to provide a satisfactory return on the new capital required, replacement becomes desirable. What constitutes a satisfactory return? Clearly, this depends on existing alter-

**Exhibit 18-6**

**Determination of the Approximate Cutoff Rate for Expansion Projects**

	<i>Budgeted amount</i>	<i>Minimum acceptable rate of return</i>	<i>Minimum return</i>
Nonprofit projects .....	\$ 500,000	-0-	-0-
Nonmeasurable-profit projects .....	\$ 1,000,000	-0-	-0-
Replacement projects .....	\$ 40,000,000	6%	\$2,400,000
Expansion projects .....	\$ 60,000,000		
Total budgeted capital investments	\$101,500,000		
Percentage average cost of capital .....	.077		
Cost of capital for total budgeted investments .....	\$ 7,815,500		
Less: Minimum return required on first three categories .....	\$ 2,400,000		
Minimum return required on ex- pansion projects to cover cost of capital .....	\$ 5,415,500		
Cutoff rate on expansion projects (\$5,415,500/\$60,000,000) .....		9%	

native investment opportunities. However, it would not be proper for replacement projects to have to contend on the same basis with expansion projects for available funds. Since replacement projects involve less risk, a lower rate of return should be acceptable.

The lack of return on nonprofit and nonmeasurable-profit projects together with the lower return required for replacement projects raise the cutoff rate on expansion projects above the average cost of money. Assuming that the average cost of capital has been calculated to be 7.7 percent, as in the earlier example, and that management considers a 6 percent return on replacement projects acceptable, the determination of the minimum, or cutoff, rate of return on expansion projects becomes 9 percent, as shown in Exhibit 18-6.

### **The equity-debt relationship**

A company's cost of capital is affected by the nature of its financial structure. A firm with high financial leverage (i.e., with a large proportion of its capital derived from creditors rather than stockholders) normally has a low capital cost.

In calculating the cost of capital, it is necessary to establish the relationship between equity and debt. Should this be based on long-run past experience, recent past, present, or expected future? Most companies probably use the present capital structure in computing their cost of capital. However, at any given moment of time, the equity-debt relationship may be distorted by a current source of capital. In the long run this tends to be counterbalanced and the desired equity-debt relationship reestablished. Since the cost of capital is used in evaluating capital investments that will extend into the future, it seems apparent that the proper relationship is one which represents management's desired future financial structure.

## *Criteria for evaluating capital investments*

The methods used for evaluating the desirability of capital investments range from intuitive guesses to mathematical models. While mathematical precision is important, it should not be a substitute for judgment. Many factors in a capital-investment decision cannot be quantified. In this book, five methods for evaluating capital investments will be considered. They are:

- |                                    |                         |
|------------------------------------|-------------------------|
| 1. Pay-off                         | 4. Discounted cash flow |
| 2. Simple interest rates of return | 5. Present value        |
| 3. Annual cost                     |                         |

### **The pay-off method**

One of the most commonly used methods for determining the desirability of property additions is the *pay-off* method. This criterion requires that

the average annual savings or income from a proposed investment be sufficient to recover the investment within a time period stipulated by the company's management. The pay-off (in years) is computed as

$$\frac{\text{Capital investment}}{\text{Average annual cash income}}$$

In Exhibit 18-7, the initial cost of a proposed replacement is \$10,000. The existing asset has a book value of \$2,600 and a realizable value of \$2,000. The company's required pay-off period (after taxes) is 4 years. Since the proposed asset is expected to be paid off in less than 4 years, replacement is indicated.

The loss to be sustained on the old asset and the depreciation of the new asset are relevant only because they represent tax deductions and thus affect the cash flow. The depreciation is the excess of the new annual depreciation charge ( $\$10,000/10$ ) over the present depreciation charge ( $\$2,600/10$ ). While it is technically incorrect to assume that the present asset's remaining life for tax purposes is equivalent to that of the proposed asset, this assumption simplifies the calculation and rarely will significantly distort the results.

The most important factor contributing to the common use of the pay-off method is the ease of calculation and comprehension. Perhaps the pay-off method has its greatest usefulness when investment funds are exceptionally scarce. It also may be used in selecting between contending proposals which are equally desirable, i.e., have the same risk and rate of return, except for their capital-recovery periods. Many companies actually combine the pay-off method with a rate-of-return calculation. Used in this manner, the method has merit.

There are serious limitations to the pay-off method, and its use may result in unwarranted investments.<sup>2</sup> Many concerns that use the pay-off method require an excessively short period of capital recovery. This has the effect of establishing an abnormally high minimum rate of return. It is not uncommon for companies that are depreciating present assets over a 10-year period to specify a 3- or 4-year pay-off period for replacements.

Under the pay-off method, an asset with a long life may fail to meet the pay-off time requirement but may yield a greater return over its life than an asset which meets the pay-off requirement but whose life does not extend much beyond the specified pay-off period. This is illustrated graphically in Fig. 18-1. Machine Y will earn a substantially greater cash return during its life than machine X, although Y does not meet the required pay-off period.

<sup>2</sup> The disadvantage of the pay-off method tends to disappear in the case of long-range projects with stable annual earnings. In such situations, the reciprocal of the pay-off in years approximates the correct rate of return based on the present value of the expected cash flow.



## Exhibit 18-7

## Pay-off Method

		Estimated average annual cost		
		Present asset	Pro- posed asset	Savings
Raw materials spoilage:				
Estimated cost of product.....	\$40,000			
Present spoilage rate.....	3%	\$1,200		
Proposed spoilage rate.....	1%		\$ 400	\$ 800
Rate per direct-labor hour.....	\$ 2			
Present productive hours.....	3,000	6,000		
Proposed productive hours.....	2,000		4,000	2,000
Overhead:				
Repairs and maintenance.....		800	650	150
Indirect labor.....		-0-	-0-	-0-
Supervision.....		-0-	-0-	-0-
Setup time.....		500	300	200
Payroll taxes.....		340	290	50
Supplies.....		375	325	50
Taxes and insurance.....		200	360	(160)
Power.....		125	150	(25)
Downtime.....		200	50	150
Total.....		<u>\$9,740</u>	<u>\$6,525</u>	<u>\$ 3,215</u>
Cash outlay required:				
Cost of proposed asset.....				\$10,000
Less: Proceeds from sale of present asset:				
Book value of present asset.....	\$2,600			
Less salvage value.....	<u>2,000</u>		\$2,000	
Loss on present asset.....	\$ 600*			
Savings in income tax at 52%.....			<u>312</u>	
Net proceeds from sale.....				<u>2,312</u>
Net cash outlay.....				<u>\$ 7,688</u>
Annual cash savings from operations:				
Estimated annual savings before depreciation.....			\$3,215	
Depreciation (10-year life).....			<u>740</u>	
Estimated additional annual taxable income.....			\$2,475	
Income tax at 52%.....			<u>1,287</u>	
Estimated additional annual income after tax.....			\$1,188	
Add depreciation.....			<u>740</u>	
Annual cash savings.....				<u>\$ 1,928</u>
Years required to pay off investment.....				<u>3.9</u>

\* Under certain circumstances a tax deduction is not permitted.



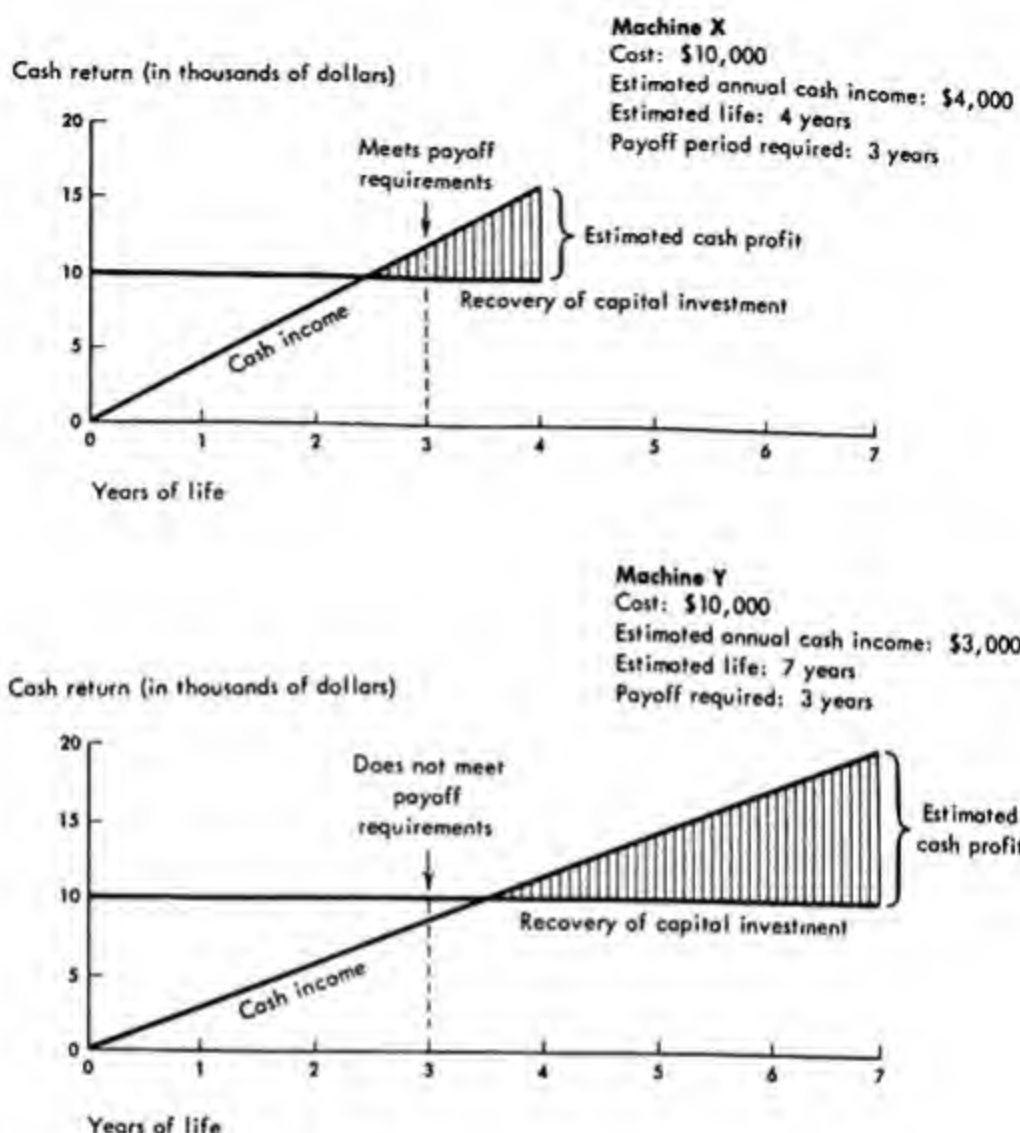


Fig. 18-1 The pay-off method.

### Simple interest rate-of-return methods

Several methods may be used to estimate the rate of return on capital investments. They fall into two broad categories: those that give consideration to the time value of money and those that do not. The latter may be referred to as simple interest methods. The simple interest methods fail to recognize that the value of money received or expended in the future is quite different from current receipts or expenditures. One such method is represented by the following formula:

$$\frac{\text{Average annual net cash return} - \text{capital recovery}}{\text{Initial capital investment}}$$

In the above formula, capital recovery represents the asset's annual decline in economic value. Because of a lack of information as to the actual loss in value, companies using the straight-line depreciation method generally equate the capital recovery with depreciation. When

an accelerated depreciation method is used, capital recovery is apt to differ from the book depreciation.

The application of the above formula may be illustrated by assuming that a prospective capital investment will cost \$10,000 and will have an estimated productive life of 10 years, with no salvage value. It is also expected that the investment will yield average annual cash revenue of \$4,000 and that cash costs, including taxes, will amount to \$2,500. Under this method, the investment would yield a return of 5 percent, i.e.,  $(\$1,500 - \$1,000)/\$10,000$ . The method, is misleading, since it does not give effect to the fact that we are dealing with an investment whose value constantly is declining. The economic value of the investment at the beginning of the second year is \$9,000 rather than \$10,000.

Another simple interest method, one which does give effect to the decline in value of the capital investment, is

$$\frac{\text{Average annual net cash return} - \text{capital recovery}}{\text{Average capital investment}}$$

Under this method, an estimated return of 10 percent is yielded, i.e.,  $(\$1,500 - \$1,000)/\$5,000$ . This procedure recognizes that there is a gradual diminishment in value over the life of an asset by relating income to average rather than initial investment. However, it fails to consider the time value of money. The present value of a dollar earned in the tenth year is considerably less than a dollar received during the first year.

Another method used for determining return on investment contains a cost factor which gives effect to imputed interest. This may be referred to as the *straight-line depreciation plus average interest* method. The interest computation is based on a diminishing capital investment. The average annual interest is the arithmetic average of the first year's interest  $P_i$  and the last year's interest  $P_i/n$ , or  $[P_i + (P_i/n)]/2$ .

This method is illustrated in Exhibit 18-8. The same facts are assumed as in the preceding illustration, except that the interest rate is set at the cost of capital to the firm.

This method appears to yield a substantially lower return (3.4 percent) in comparison with the preceding method (10 percent). This is because the imputed interest has been included as a separate cost factor. Actually this method produces a combined return of 9.4 percent (6 percent interest and 3.4 percent reward for risk).

#### Exhibit 18-8

##### Straight-line Depreciation Plus Average Interest Method

Average annual revenue.....	\$4,000	
Average annual operating costs.....	\$2,500	
Capital recovery.....	1,000	
Imputed interest (6%).....	330	3,830
Net annual return.....		\$ 170
Average capital investment.....		\$5,000
Return on investment.....		3.4%

There are some advantages to this procedure. Like the other simple interest methods, it avoids the use of interest tables and formulas. It gives effect to the loss of potential interest income as a consequence of investing the funds in this project. This method also separates the cost of capital factor from the reward for risk. However, the return computed under this method is inexact, because, like the other simple interest methods, it fails to give consideration to the time value of money.

Another deficiency of the simple interest methods is that they cannot be applied to capital investments that are expected to have uneven cash flows. Many capital investments have irregular cash flows. Frequently, an asset will yield less revenue in its early years of service. This is likely to occur when the revenue emerges from a product which is being introduced into a competitive market and first must establish itself. Other investments may obtain more revenue during the early years of their lives, as, for example, when a newly introduced product temporarily "captures" the market. Cost outlays also may follow an irregular pattern. Repair and maintenance costs tend to increase during the later years of operation.

During recent years, the theory and practice of capital-investment budgeting has become much more refined. This is evidenced by the number of companies that have discarded simple interest rate-of-return calculations in favor of methods that give effect to the time value of money. These methods, which all embody the principle of discounting future values, are the annual-cost method, the discounted cash flow method, and the present-value method.

### The annual cost method

In the annual cost method, a comparison is made between two or more investment opportunities. All costs, capital as well as operating, are converted into equivalent annual costs, and the project which has the lowest time-adjusted annual cost is selected. Interest tables are used to determine the equivalent annual cost, the rate of interest being established at the cost of capital to the firm.

Exhibits 18-9 and 18-10 provide illustrations of the annual cost method.

#### Exhibit 18-9

Annual Cost Method  
Selecting between Two Alternatives

	<i>Capital investment</i>	<i>Capital-recovery factor*</i>	<i>Equivalent annual cost</i>
Vat A.....	\$ 5,000	.3503	\$1,751.00
Vat B.....	12,000	.1710	2,052 00

\* From Table IV in the Appendix.

In Exhibit 18-9, it is assumed that a chemical company is faced with a choice between purchasing two vats, each of which will perform equally satisfactorily. Vat A costs \$5,000 and has a life of 4 years. Vat B costs \$12,000 but has a life of 15 years. The pretax cost of capital to the firm is estimated at 15 percent.

The capital recovery factor

$$P \left[ \frac{i(1+i)^n}{(1+i)^n - 1} \right]$$

converts a present investment of \$1 into equal annual costs, dependent on the life of the investment and interest rate used. Table IV in the Appendix contains the capital-recovery factor. Referring to Table IV, we look under the interest rate of 15 percent for a 4-year time period. The table indicates that \$1 invested today in an asset with no salvage value at the end of its 4-year life, at 15 percent, represents an annual cost of \$.3503. Multiplying this capital-recovery factor by 5,000 produces the equivalent annual cost for vat A of \$1,751.50. Following the same procedure for vat B, we obtain an equivalent annual cost of \$.1710  $\times$  \$12,000, or \$2,052. Since vat A has the lower annual cost, it represents the more economical of the two alternatives.

The annual cost method also may be used to calculate the optimum economic life of an asset. This is useful for companies that possess a large number of identical assets, e.g., taxicabs, sewing machines, tractors, electric motors. In such situations, the longer the life of the asset, the lower its average annual capital cost becomes, since the outlay is spread over a longer period of time. However, this is offset by rising operating costs. The optimum economic life occurs during that year in which the time-adjusted annual cost of capital combined with operating costs is lowest.

In Exhibit 18-10, it will be assumed that a transportation company is using a large number of identical trailer trucks costing \$15,000 each, that the cost of capital is 15 percent, and that the annual operating costs and year-end salvage values are as follows:

Year	Operating costs	Salvage value
1	\$ 4,600	\$10,000
2	5,100	7,000
3	5,700	4,500
4	6,300	2,500
5	7,000	2,000
6	7,900	1,500
7	9,000	1,000
8	10,200	500
9	11,500	-0-
10	12,900	-0-



## Exhibit 18-10

Annual Cost Method  
Determining the Optimum Economic Life of an Asset\*

End of year	Annual cost of capital investment	Annual (negative) cost of salvage	Operating costs			Total combined annual cost
			Present worth of annual operating cost	Cumulative present worth of annual operating cost	Annual cost	
1	\$17,250	\$(10,000)	\$4,000	\$ 4,000	\$4,600	\$11,850
2	9,230	(3,260)	3,860	7,860	4,830	10,800
3	6,570	(1,300)	3,750	11,610	5,090	10,360
4	5,260	(500)	3,600	15,210	5,330	10,090
5	4,480	(300)	3,480	18,690	5,580	9,760
6†	3,960	(170)	3,410	22,100	5,840	9,630
7	3,610	(90)	3,380	25,480	6,120	9,640
8	3,340	(40)	3,340	28,820	6,420	9,720
9	3,140	-0-	3,270	32,090	6,730	9,870
10	2,990	-0-	3,190	35,280	7,030	10,020

\* Figures rounded to nearest \$10.

† Optimum economic life.

As indicated in Exhibit 18-10, the optimum economic life of a trailer truck is 6 years. Assuming a tractor has a 3-year life, the data appearing in Exhibit 18-10 are calculated as follows. For different estimated lives, the calculations follow the same procedure.

**Annual cost of investment.** If we assume that a trailer truck has a 3-year life, the annual time-adjusted capital cost at 15 percent interest rate is \$6,570, calculated as follows:

Years of life.....	3
Capital-recovery cost (from Table IV in the Appendix).....	\$4,380
Capital investment.....	\$15,000
Annual capital-recovery cost.....	\$6,570

**Annual (negative) cost of salvage.** The annual time-adjusted cost of salvage is calculated in two steps. It first is necessary to determine the present value of the salvage. This is done by referring to Table II in the Appendix. The present value of \$1 received in the future at a stipulated rate of interest is shown in this table. Multiplying the present-value factor by the amount of estimated salvage at the end of each year provides the present value of the salvage. This is then converted into an annual (negative) cost by using the capital-recovery factor in Table IV of the Appendix. Referring to our illustration, at the end of the third year a



trailer truck will have an estimated value of \$4,500, and the calculation of its annual (negative) cost is as follows:

*Step 1: Determining the Present Value of Salvage:*

End of year.....	3
Salvage value.....	\$4,500
Present-value factor @ 15 % (from Table II in the Appendix).....	\$.658
Present value of salvage.....	\$2,960

*Step 2: Determining the Annual (Negative) Cost of Salvage:*

Years of life.....	3
Capital-recovery factor @ 15 % (from Table IV in the Appendix)....	\$.4380
Present value of salvage.....	\$2,960
Annual cost of salvage.....	\$1,300

**Annual cost of operating.** The present value of operating costs is calculated by multiplying each year's actual annual operating cost by the appropriate present-value factor in Table II in the Appendix. The present value of each year's operating cost then is totaled so as to yield the cumulative present value of all the operating costs for the asset's estimated life. The appropriate capital-recovery factor in Table IV of the Appendix is then applied to the cumulative present value of the operating costs to determine the annual time-adjusted operating costs. In our illustration, the annual time-adjusted cost of operating a trailer truck with a 3-year life is calculated as follows:

*Step 1: Calculating the Cumulative Present Value of Operating Costs:*

	Year		
	1	2	3
Annual operating cost.....	\$4,600	\$5,100	\$5,700
Present-value factor @ 15 % (from Table II in the Appendix).....	\$.870	\$.756	\$.685
Present value.....	\$4,000	\$3,860	\$3,750
Cumulative present value.....	\$4,000	\$7,860	\$11,610

*Step 2: Calculating the Time-adjusted Cost of Operating:*

End of year.....	3
Cumulative present value of annual operating costs.....	\$11,610
Capital-recovery factor @ 15 % (from Table IV in the Appendix)....	\$.4380
Time-adjusted annual cost of operating.....	\$5,090

**Total combined annual capital-recovery and operating cost.** This is equal to the total of the figures calculated in the preceding steps. In our illustration, it is equal to \$10,360 per year, as shown on the following page.

Annual cost of capital.....	\$ 6,570
Annual (negative) cost of salvage.....	(1,300)
Annual cost of operating.....	5,090
Total annual cost for 3-year life.....	<u>\$10,360</u>

In Exhibit 18-10, the time-adjusted annual cost is shown for other life expectancies up to a maximum of 10 years, calculated in the same manner as illustrated in the foregoing data for a 3-year life.

### The discounted cash flow method

Under the discounted cash flow method, it is necessary to calculate the interest rate which will discount the expected future cash flow back to the present value of the investment. This interest rate must be sought in the interest tables by trial and error.

If the cash flow is the same each year during the life of the investment, an annuity exists, and Table I in the Appendix, which discloses the present value of an annuity of \$1, is used. If the cash flow is irregular, the cash income for each year must be separately discounted. In the latter case, reference is made to Table II in the Appendix.

It will be noted that only the net cash income or savings is relevant and that no provision appears to be made for the loss in asset value, i.e., capital recovery. The reason for this is that the recovery of capital is provided for in the interest tables, as will be seen in the proof of the illustration which follows.

In the data used to illustrate the simple interest methods, we dealt with a \$10,000 investment proposal that was expected to yield \$1,500 for 10 years, i.e., before capital recovery. This is equivalent to an annuity of \$1,500 for 10 years. Accordingly, under the discounted cash flow method, we must find the rate of interest in Table I that will make the 10-year stream of income equal to \$10,000, the present value of the investment. Referring to the table, we find that the present value of a \$1,500 annuity for 10 years at 8 percent is \$10,065 and at 10 percent is \$9,218. As shown below, the rate of return on this investment is 8.16 percent. Exhibit 18-11 contains proof of the accuracy of the rate and shows how provision for capital recovery is provided for in the tables.

Present value of \$1,500 @ 8% ( $\$1,500 \times 6.71$ ).....	\$10,065
Capital investment.....	\$10,000
Present value of \$1,500 @ 10% ( $\$1,500 \times 6.145$ ).....	\$9,218
Present value at 8% less capital investment.....	\$65
Present value at 8% less present value at 10%.....	\$847
Actual rate: $8\% + [(65 \times 2\%)/847]$ .....	8.16%

When an annuity exists, time may be saved in locating the correct interest rate by the following procedure: (1) divide the investment by the annual cash flow; and (2) refer to the life expectancy of the investment in Table I, locate the interest rates closest to the figure just derived,

## Exhibit 18-11

## Proof of Discounted Cash Flow Method

Year	Balance of capital investment beginning of year	Net cash receipts	Return on beginning of year investment at 8.16%	Portion of cash receipts applied to reduction of capital investment
1	\$10,000	\$1,500	\$816	\$ 684
2	9,316	1,500	760	740
3	8,576	1,500	700	800
4	7,776	1,500	635	865
5	6,911	1,500	564	936
6	5,975	1,500	488	1,012
7	4,963	1,500	405	1,095
8	3,868	1,500	314	1,186
9	2,682	1,500	219	1,281
10	1,401*	1,500	114	1,386*

\* Difference is due to rounding.

and interpolate. Thus, in our illustration  $\$10,000/\$1,500 = 6.67$ , which is between 8 and 10 percent on the 10-year line of Table I in the Appendix.

The discounted cash flow method, like the annual cost method, is useful in selecting among two or more competing capital proposals with different cash flows and estimated lives under certain conditions. Exhibit 18-12 shows that machine A yields a higher rate of return, although its annual cash income is \$400 less than that of machine B. This, of course, is due to its longer life.

The discounted cash flow method is particularly useful in situations where the estimated net cash receipts do not follow an even flow. Table I in the Appendix is no longer relevant, since we now are not dealing with an annuity type of cash flow. Instead, we must refer to Table II of

## Exhibit 18-12

## Comparison of Competing Proposals—Discounted Cash Flow Method

	Machine A (estimated 15- year life)	Machine B (estimated 10- year life)
Initial cost.....	\$8,000	\$10,000
Estimated average annual cash revenue.....	\$2,200	\$ 2,700
Less: Estimated average annual cash costs....	900	1,000
Estimated net cash income.....	\$1,300	\$ 1,700
Rate of return (from Table I, Appendix).....	14%	11.1%

## Exhibit 18-13

Use of Discounted Cash Flow Method  
For Irregular Annual Cash Flows

Year	Estimated net cash receipts	Present value of \$1 at 12% (Table II, Appendix)	Present value of cash receipts at 12%	Present value of \$1 at 10% (Table II, Appendix)	Present value of cash receipts at 10%
1	\$12,000	.893	\$10,716	.909	\$10,908
2	12,000	.797	9,564	.826	9,912
3	12,000	.712	8,544	.751	9,012
4	8,000	.636	5,088	.683	5,464
5	8,000	.567	4,536	.621	4,968
6	8,000	.507	4,056	.564	4,512
7	4,000	.452	1,808	.513	2,052
8	4,000	.404	1,616	.467	1,868
9	2,000	.361	722	.424	848
10	2,000	.322	644	.386	772
Total . . .	\$72,000		\$47,294		\$50,316

NOTE: By interpolation, rate of return = 10.2%

the Appendix, which shows the present value of \$1 earned or paid out at different interest rates and at a specified number of years in the future. This type of calculation may be illustrated by assuming that we are seeking the return on a \$50,000 capital investment, with an expected life of 10 years and no salvage value. It is estimated that the net cash receipts from the asset will amount to \$72,000 and will be greater in the earlier years, as indicated in Exhibit 18-13. By interpolation, a rate of return of 10.2 percent is obtained.

In actual practice, calculating return on investment may be more complicated than indicated by the preceding discussion. This is illustrated in the case presented in the Chapter Supplement.

### The present-value method

Under the present-value method, the estimated cash income during the life of a proposed capital investment is discounted at an established interest rate. The interest rate used will vary according to the risk involved but should be higher than the cost of capital to the firm. As long as the present value of the projected cash flow exceeds the present value of the capital investment, the company is assured that the estimated return is greater than the minimum that it is willing to accept, considering the risk involved.

Exhibit 18-14 presents two illustrations of the present-value method. In case A, the cash flow represents an annuity, and Table I in the Ap-

*Exhibit 18-14*

## The Present-value Method

*Case A:*

## Facts:

Capital investment.....	\$10,000
Estimated annual cash income.....	\$3,200
Life of project.....	5 years
Rate of return stipulated.....	20%

## Solution:

Annual cash income.....	\$3,200
Present value of \$1 @ 20% for 5 years.....	\$2,991
Present value of cash flow.....	\$9,571

(Since present value of cash flow is less than present value of capital investment, the project is rejected.)

*Case B:*

## Facts:

Capital investment.....	\$8,000
Estimated annual cash income:	
First year.....	3,600
Second year.....	3,000
Third year.....	2,800
Fourth year.....	2,000
Fifth year.....	1,000
Rate of return stipulated.....	20%

## Solution:

<i>Year</i>	<i>Annual cash income</i>	<i>Present value of \$1 @ 20%</i>	<i>Present value of cash flow</i>
1	\$3,600	.833	\$2,999
2	3,000	.694	2,082
3	2,800	.579	1,621
4	2,000	.482	964
5	1,000	.402	402
Total.....			\$8,068

(Since the present value of the cash flow exceeds the present value of investment, the project is approved.)

pendix is used. In case B, the cash flow is irregular, and Table II in the Appendix is used. Since in case A the cash flow discounted at the desired rate of return is less than the present value of the investment, the proposal is rejected. The reverse is true in case B, and the investment is approved.

It is evident that since the rate of return is stipulated, the present-value method avoids the need of calculating the correct interest rate,



## CAPITAL EQUIPMENT REPLACEMENT ANALYSIS

1. Subject of Analysis

2. Replacement - Milling Machine

3. Anticipated Rate of Production

## PROPOSED EQUIPMENT

4. Description: \_\_\_\_\_

5. \_\_\_\_\_

6. Est. Primary Service Life: 10 Years7. Est. Terminal Salvage Value = (X) = \$ 1208. Est. Cost Installed = (Y) = \$ 40009. Terminal Salvage Factor =  $\frac{X}{Y} = \underline{3} \%$ 

## EXISTING EQUIPMENT

Purch. Date: \_\_\_\_\_ Tool No. \_\_\_\_\_

Description: \_\_\_\_\_

Years of life  
to Date: 8 Installed Cost: 2600

Location: \_\_\_\_\_ Dept. No.: \_\_\_\_\_

Intended Resale, Salvage or  
Disposal \_\_\_\_\_ Conversion Value \$ 900

## FACTOR

## PROPOSED EQUIPMENT EXISTING EQUIPMENT

10. Direct Labor (For Anticipated Production):	\$ <u>4700</u>	\$ <u>5,000</u>
11. Indirect Labor (For Anticipated Production):	—	—
12. Defective Material Labor and Works Expense:	<u>1600</u>	<u>1,700</u>
13. Down Time:	<u>200</u>	<u>500</u>
14. Power Consumption:	—	—
15. Tooling:	—	—
16. Supplies:	—	—
17. Floor Space: (if usable)	—	—
18. Property Taxes and Insurance:	—	—
19. Normal Maintenance:	<u>550</u>	<u>600</u>
20. Special Repairs:	<u>150</u>	<u>200</u>
21. Sub Contract Costs:	—	—
22. Other Items (explain on reverse side):	—	—
23.		

Totals: B \$ 7,200 A \$ 8,00025. B \$ 7,20026. Next Yrs. Variance in Operating Cost: (A Minus B): C \$ 800

27. (Next Years Capital Cost of Retaining Existing Equipment)

28. Restorative Repairs \$ 800 + (Restorative Repairs \$ 800 X 6%) D \$ 248  
Years Effective 429. Resale, Salvage or Conversion Value  
of Existing Equipment \$ 900 X 6% E \$ 5430. Salvage Value Loss, Next Year 500 F \$ 50031. Total Next Yrs. Cost for Existing Equipment (C + D + E + F) G \$ 160232. Total Next Yrs. Cost for Proposed Equipment Chart 7 % + Int. 6% Total 13 % X \$ 4,000 Est. Cost Installed H \$ 52033. First Years Gain (+) or Loss (-) thru replacing existing equipment (G-H) (taking into account Depreciation, Loss of Efficiency and 6% return on Investment) 1082

Approved by: \_\_\_\_\_ Date: \_\_\_\_\_ Calculated by: \_\_\_\_\_ Date: \_\_\_\_\_

Fig. 18-2 Capital equipment replacement analysis: the Terborgh method.

## CAPITAL EQUIPMENT ANALYSIS CHART

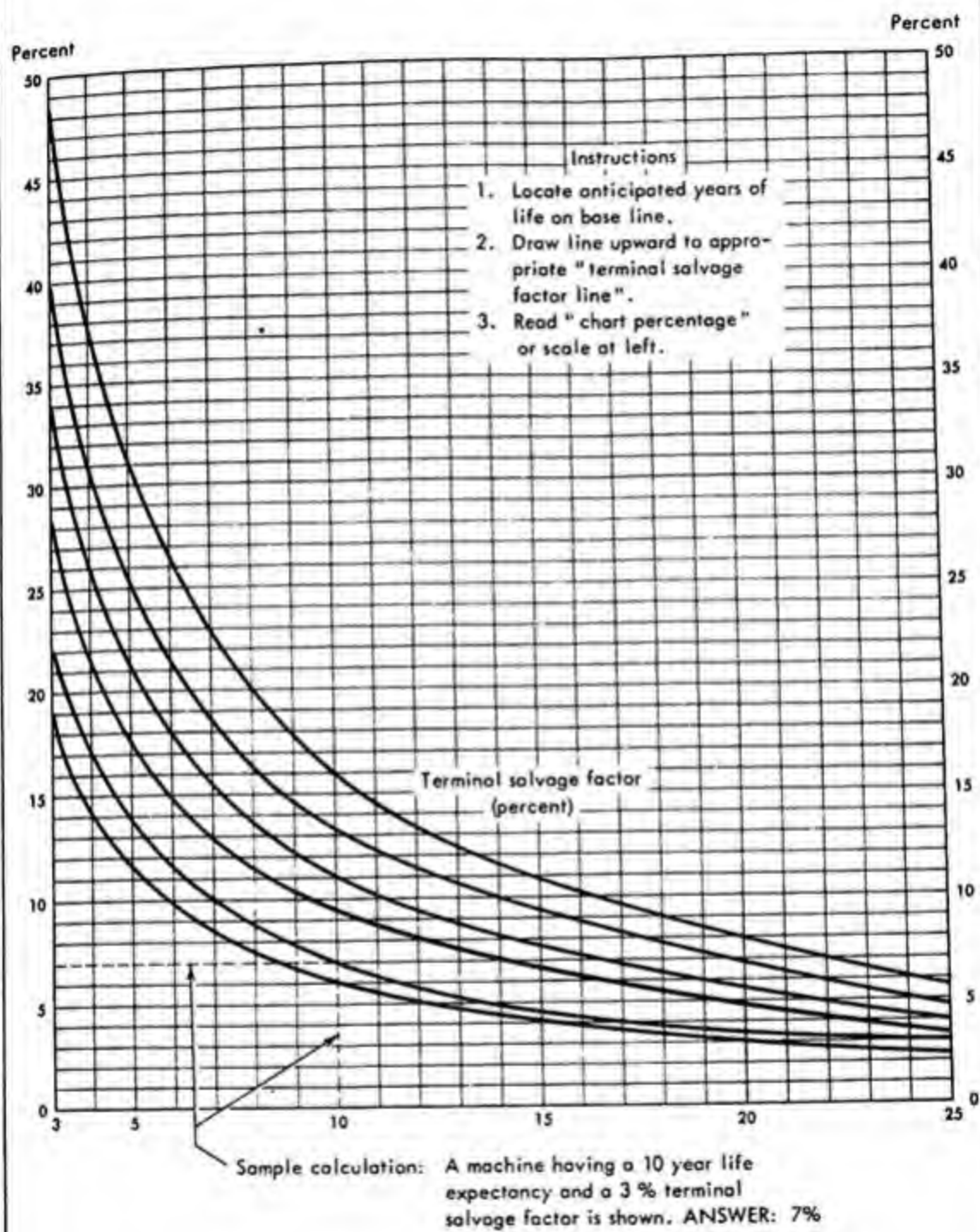


Fig. 18-3 Capital equipment analysis chart: the Terborgh method.

as under the discounted cash flow method. However, under the present-value method, management cannot be informed as to the precise rate of return expected on an investment.

This disadvantage of the present-value method has largely been overcome by using the cost of capital as the interest rate and calculating indices which indicate the extent to which the cost of capital or minimum rate is exceeded. The present-value index is equal to the discounted cash flow divided by the present value of the capital investment. If we assume in case B of Exhibit 18-14 that the 20 percent interest rate represents the cost of capital, the present-value index is 1.01, i.e., 8,068/8,000. Investments with greater risks would require higher present-value index ratings for approval.

### The Terborgh method

Important contributions to the theory and practice of capital budgeting have been made by George Terborgh. Perhaps the most interesting aspect of the Terborgh, or MAPI, method relates to the timing of replacements. In replacement decisions we are confronted with the alternatives of continuing to use the present asset for a longer period of time or replacing it. The Terborgh method determines the economic desirability of making the replacement by comparing the "adverse minimum" cost of the present asset with that of its challenger. The adverse minimum cost is defined as "... the lowest time-adjusted average of capital cost and operating inferiority obtainable from one machine."<sup>3</sup> The Terborgh method essentially represents an extension of the annual cost procedure. Terborgh has developed a simple graphic method for determining the timing of replacements (Figs. 18-2 and 18-3). While a comprehensive discussion of the Terborgh method is beyond the scope of this book, readers particularly interested in the theory of capital budgeting may wish to be familiar with Terborgh's *Dynamic Equipment Policy*.

## Other aspects of capital budgeting

### Initiation of projects

The initiation of a capital-investment proposal generally begins with a request for project authorization at the department or plant level. In some plants, a standing profit improvement committee is charged with the responsibility for seeking out and evaluating capital projects. If a project is approved, it is included in the division's capital budget, which is submitted to the president or an executive committee for final approval. The amount of capital investments that can be approved at different corporate levels generally is specified. In many large companies, the

<sup>3</sup> George W. Terborgh, *Dynamic Equipment Policy* (New York: McGraw-Hill Book Company, 1949), p. 64.

final capital budget is submitted to the board of directors together with a schedule showing the proposed sources for financing the expenditures.

### **The budget period**

A company should have both long-range and short-range capital budgets. The long-term capital budget deals with uncommitted funds. It need not be a detailed or formal type of document and may consist of a general estimate of capital needs based upon marketing expectations during the next 5, 10, or 15 years. The principal advantage of a long-run capital budget is that it serves as a guide to present capital financing and dividend policies.

The short-term capital budget generally covers a period of 1 or 2 years. It consists of uncompleted projects carried over from prior years plus new capital expenditures that have been approved. It is supported by project details which describe the nature of each investment, timing of expenditures, and estimated profitability, i.e., where profit improvement is the objective and is measurable.

### **Audits of capital expenditures**

After a capital-investment project has been undertaken, it is desirable to determine whether the expected return on investment has been attained. This may be accomplished by an audit of the actual expenditures and revenue attributable to the project. The audit may occur during the life of the project or at its completion. Many companies use a formal system of reporting which compares project estimates with actual results. The following advantages may be derived from this procedure:

1. When executives are aware that their project estimates will be audited, they are likely to exercise greater care in the preparation of the data.
2. Postcompletion audits often reveal the causes for errors contained in the original estimates. This leads to more precise estimating in the future.
3. Audits disclose the reasons for not achieving the expected return on investment. Often, it may be possible to take additional action to restore the desired profitability.

## ***Chapter supplement: discounted cash flow method\****

### **Nature of proposal**

The capital-investment proposal under consideration concerned the acquisition and construction of a new marketing wholesale plant. The

\* Based upon material furnished by Socony Mobil Oil Company, Inc.



company was to finance the purchase of land and construction of the plant, and to hold title to the land, building, and other improvements.

### Investment factors

Investment factors include (1) initial cash outlays, (2) subsequent cash outlays, (3) cash recoveries, (4) yearly cash intake, and (5) length of economic life. The first three factors are shown below:

<i>Nature of investment</i>	<i>Time of expenditure</i>	<i>Amount</i>
Initial cash outlays:		
Land.....	3 years before O*	\$100,000
Plant construction.....	2 years before O	250,000
Plant construction.....	1 year before O	150,000
Plant construction.....	O*	100,000
Electric pumps.....	O	150,000
Loading racks.....	O	125,000
Total initial cash outlays.....		\$875,000
Subsequent cash outlays:		
Electric pumps.....	21 years after O	\$150,000
Cash recoveries:		
Land.....	30 years after O	\$100,000
Electric pumps.....	30 years after O	42,262
Total cash recoveries.....		\$142,262

\*"O" is the point at which the proposed project starts to operate.

Yearly cash intake estimates are shown in Exhibit 18-16. Economic lives for computing depreciation by the sum-of-the-years-digits method are as follows:

Wholesale plant.....	30 years
Electric pumps.....	20 years
Loading racks.....	35 years

The calculation of the return on investment appears in Exhibits 18-15 and 18-16. In a project such as this, where the capital expenditures occur at different time intervals and where the cash intake flow is irregular, the proper rate of return is that which equates the present value of the cash intakes with the present value of the cash outlays. The present value of the cash outlays is shown in Exhibit 18-15. In Exhibit 18-16, it is necessary to calculate the income tax outlay before the net cash intake can be determined. Depreciation, which is not a cash outlay, must be computed in order to determine the income taxes. In this illustration, the sum-of-the-years-digits method was used for depreciation. The first year's depreciation (Exhibit 18-16) was calculated as follows:



<i>Asset</i>	<i>Cost</i>	<i>Sum-of-the-years digits factor</i>	<i>Depreciation</i>
Building.....	\$500,000	.0645	\$32,258
Loading racks.....	125,000	.0556	6,945
Electric pumps.....	150,000	.0952	14,285
Total.....			\$53,488

The rate of return of 10.6 percent was arrived at by interpolation. This is the only rate that will equate the present value of the cash intakes with the cash outlays.

In the foregoing case, it will be noted that the investment had a residual value at the end of its life. The present value of this residue was calculated and deducted from the present values of the initial and subsequent investments.

The same type of calculation frequently is used in regard to working capital. Increases in working capital are a part of the total capital investment. The present value of annual increases or decreases in working capital minus the present value of the residual working capital remaining at the end of the project's life should be handled in exactly the same manner as the present value of cash intakes and cash outlays for land and electric pumps in the preceding illustration.

### Exhibit 18-15

#### Project Analysis

<i>Nature of investment</i>	<i>Cash outlay estimates</i>		<i>Rate-of-return computation</i>			
	<i>Year</i>	<i>(1) Cash outlays</i>	<i>(2)</i>	<i>(3)</i>	<i>(4)</i>	<i>(5)</i>
			<i>Present- value factor @ 10 %</i>	<i>Present values</i>	<i>Present- value factor @ 12 %</i>	<i>Present values</i>
				<i>(1) × (2)</i>		<i>(1) × (4)</i>
Initial cash outlays:						
Land.....	3 years before O	\$ 100,000	1.331	\$133,100	1.405	\$ 140,500
Plant construction.....	2 years before O	250,000	1.210	302,500	1.254	313,500
Plant construction.....	1 year before O	150,000	1.100	165,000	1.120	168,000
Plant construction, electric pumps, etc.....	O	375,000	1.000	375,000	1.000	375,000
Subsequent cash outlays:						
Electric pumps.....	21 years after O	150,000	.135	20,265	.093	13,950
Cash recoveries:						
Land.....	30 years after O	(100,000)	.057	(5,730)	.033	(3,300)
Electric pumps.....	30 years after O	(42,262)	.057	(2,422)	.033	(1,400)
Net cash outlays.....		\$ 882,738		\$987,713		\$1,006,250

NOTE: The present-value factors, applied to cash outlays which occur prior to the earning of revenue, appear in Table III of the Appendix. The present-value factors for future cash outlays are obtained from Table II of the Appendix.

Exhibit 18-16

Project Analysis

Year	Cash intake estimates					Rate-of-return computation			
	(1) Earnings before depreci- ation and income taxes	(2) Depreci- ation (sum-of- the-years- digits method)	(3) Taxable income  (1) - (2)	(4) Income taxes  (3) × 54%	(5) Cash intake  (1) - (4)	(6) Present- value factor @ 10%	(7) Present values  (5) × (6)	(8) Present- value factor @ 12%	(9) Present values  (5) × (8)
1 year after O . . . . .	\$170,000	\$53,488	\$116,512	\$ 62,916	\$ 107,084	.909	\$ 97,350	.893	\$ 95,626
2 years after O . . . . .	175,000	51,501	123,499	66,689	108,311	.826	89,508	.797	86,324
3 years after O . . . . .	180,000	49,513	130,487	70,463	109,537	.751	82,295	.712	77,990
4 years after O . . . . .	185,000	47,524	137,476	74,237	110,763	.683	75,651	.636	70,445
5 years after O . . . . .	190,000	45,537	144,463	78,010	111,990	.621	69,535	.567	63,498
6 years after O . . . . .	200,000	43,548	156,452	84,484	115,516	.564	65,209	.507	58,567
7 years after O . . . . .	200,000	41,560	158,440	85,558	114,442	.513	58,732	.452	51,728
8 years after O . . . . .	200,000	39,573	160,427	86,631	113,369	.467	52,887	.404	45,801
9 years after O . . . . .	200,000	37,585	162,415	87,704	112,296	.424	47,625	.361	40,539
10 years after O . . . . .	200,000	35,597	164,403	88,778	111,222	.386	42,876	.322	35,813
11 years after O . . . . .	205,000	33,608	171,392	92,552	112,448	.350	39,413	.287	32,273
12 years after O . . . . .	205,000	31,621	173,379	93,625	111,375	.319	35,484	.257	28,623

13 years after O . . . . .	205,000	29,632	175,368	94,699	110,301	.290	31,954	.229	25,259
14 years after O . . . . .	205,000	27,645	177,355	95,792	109,208	.263	28,722	.205	22,392
15 years after O . . . . .	205,000	25,657	179,343	96,845	108,155	.239	25,892	.183	19,792
16 years after O . . . . .	210,000	23,663	186,337	100,622	109,378	.218	23,801	.163	17,829
17 years after O . . . . .	210,000	21,681	188,319	101,692	108,308	.198	21,423	.146	15,813
18 years after O . . . . .	210,000	19,692	190,308	102,766	107,234	.180	19,291	.130	13,940
19 years after O . . . . .	210,000	17,705	192,295	103,839	106,161	.164	17,357	.116	12,315
20 years after O . . . . .	210,000	15,717	194,283	104,913	105,087	.149	15,616	.104	10,929
21 years after O . . . . .	210,000	28,015	181,985	98,272	111,728	.135	15,094	.093	10,391
22 years after O . . . . .	210,000	26,026	183,974	99,346	110,654	.123	13,588	.083	9,184
23 years after O . . . . .	210,000	24,038	185,962	100,419	109,581	.112	12,240	.074	8,109
24 years after O . . . . .	210,000	22,050	187,950	101,493	108,507	.102	11,013	.066	7,161
25 years after O . . . . .	210,000	20,064	189,936	102,565	107,435	.092	9,906	.059	6,339
26 years after O . . . . .	200,000	18,074	181,926	98,240	101,760	.084	8,538	.053	5,393
27 years after O . . . . .	200,000	16,087	183,913	99,313	100,687	.076	7,682	.047	4,732
28 years after O . . . . .	200,000	14,099	185,901	100,387	99,613	.069	6,903	.042	4,184
29 years after O . . . . .	200,000	12,111	187,889	101,460	98,540	.063	6,208	.037	3,646
30 years after O . . . . .	200,000	10,122	189,878	102,534	97,466	.057	5,585	.033	3,216
Total cash intakes . . . . .					\$3,248,156		\$1,037,378		\$ 887,851
Less: Net cash outlays [Exhibit 18-15] . . . . .					882,738		987,713		1,006,250
Excess cash intakes over net cash outlays . . . . .					\$2,365,418		\$ 49,665		\$ (118,399)

NOTE: Rate of return = 10.6%.

## Problems and cases

- 18-1 *The pay-off method.* It has been argued that the pay-off method generally provides a built-in safety margin to allow for risk and uncertainty. Comment.
- 18-2 *Capital-investment procedure.* You are requested by the president and principal stockholders of the Melody Music Box Corporation to submit a report containing a recommended capital-investment procedure for the company. The company is a closed corporation, and the market value of its stock is not known. The company consists of several small plants located in different parts of the country and a home office in Chicago. The president does not believe in the effectiveness of committees and likes to make all major decisions himself. However, the company has been expanding rapidly, and the president does not have the time to consider details. The company at present is using the pay-off method for evaluating capital-investment proposals.
- Required:*
1. In outline form indicate the topics that you would include in the report.
  2. How should the cost of capital be calculated in a closed corporation such as this?
- 18-3 *Capital recovery and depreciation.* Under the present value and discounted cash flow methods, capital recovery of initial investment increases each year during the life of an asset. However, for accounting purposes, depreciation may be the same each year (straight-line method) or may decline (accelerated-depreciation method). Does this invalidate the effectiveness of these two methods?
- 18-4 *Nonquantitative criteria.* The president of a large company has allotted available funds to an investment proposal with a calculated return of 15 percent in preference to one with an estimated return of 20 percent. The chief industrial engineer has been critical of this decision and seems to have lost respect for his boss's judgment. Do you agree with the engineer?
- 18-5 *Price fluctuations and capital investments.* Do you believe that consideration should be given in capital-investment decisions to possible future changes in the value of the currency?
- 18-6 *Follow-up on capital investments.* The internal auditor of a large corporation has received a memo from the vice-president of finance, criticizing the audit department for never having included in their audits follow-ups of capital investments made by the company. Do you think this is a proper function of internal auditing? On the assumption that you do, prepare an audit program, indicating the general audit steps required to verify capital investments.
- 18-7 *Changes in source of capital and cost of capital.* "Last year, 60 percent of our long-term capital was procured from common stockholders. This year, since we issued additional common stock, 70 percent of our funds is derived from this source." What effect does this have on the cost of capital? Should a company's cost of capital be recalculated each time a change in its capital structure occurs?
- 18-8 *Cost of capital.* In a class lecture, a professor argued that the cost of capital derived from common stock is reflected in the earnings-price per share ratio.

A student inquired, "Yesterday, the earnings-price ratio for IBM was 1 to 70 and for Atlantic Refining 1 to 15. Does this mean that the cost of capital derived from common stockholders is 4.7 times greater for Atlantic Refining than for IBM? Do you really think IBM stockholders would be satisfied to earn only 1.4 percent on new capital investments?"

*Required:* Suppose you were the professor; how would you answer this question?

**18-9** *Cost of equity capital.* Ezra Solomon states that "there are at least four possible criteria in use for measuring the cost of equity capital (derived from the issue of new common stock). Of these, only one is valid." He lists the four possible criteria as follows:

1. A project should be accepted if the rate of return which it promises is higher than the rate of return currently being earned on existing corporate capital.
2. A project should be accepted if the rate of return it promises is higher than the present ratio of dividend payments to the market price of existing shares.
3. In order to be acceptable, a project's rate of return has to be higher than present earnings per share relative to present market value per share. . . . we shall refer to this measure as  $E/P$ .
4. . . . Instead of  $E$ , the current earnings per share, the numerator should measure management's best estimate of what average future earnings would be if the proposed capital expenditure were not made. We shall refer to this concept as  $E_A$ .<sup>1</sup>

Assume that the following data apply to a corporation:

1. Total book value of plant and equipment.....	\$30,000,000
2. Total capitalization.....	1,000,000 shares
3. Current earnings, \$3 per share, or.....	\$3,000,000
4. Current dividend, \$2 per share, or.....	\$2,000,000
5. Current market value \$20 per share	
6. Best estimate of future annual earnings without expansion project.....	\$3,300,000
7. Best estimate of future annual earnings if expansion project is accepted.....	\$4,200,000
8. Salvage value of project.....	\$6,000,000
9. Present outlay required for project.....	\$6,000,000
10. Underwriting and flotation expenses.....	-0-

*Required:*

1. Using each of the four criteria for the foregoing data, what would be the company's cost of capital derived from the sale of common stock?
2. What principal argument can you provide to support each method?
3. What are the limitations of each of these methods?
4. Which of the four methods is the only theoretically sound criterion? Why?
5. Which method is likely to be most commonly used in practice? Why?

**18-10** *Choosing between alternative investment possibilities.* A milk company has a choice in purchasing vats. Vat A costs \$6,000 and has an estimated life of 10 years. Vat B costs \$8,000 and will last 15 years. The company's cost of capital before income tax is 16 percent. Which type of vat should it purchase?

<sup>1</sup> The quotations and material in the problem are derived from Ezra Solomon, "Measuring a Company's Cost of Capital," *Journal of Business*, School of Business of the University of Chicago, October, 1955.



- 18-11 *Evaluation of capital-investment calculation.* A company is considering the replacement of an existing machine with a similar-purpose but improved machine. The following data were submitted to the president:

Present machine:

Cost.....	\$12,000
Accumulated depreciation.....	6,000
Book value.....	\$ 6,000
Less: Salvage value.....	1,000
Loss to be sustained if replaced.....	\$ 5,000

Proposed machine (10-year life)..... \$10,000

Estimated cost savings per annum:

Labor hours saved.....	1,000	
Average present rate per hour.....	\$2.00	
Savings in labor.....	\$2,000	\$2,000
Plant overhead rate.....	150%	
Savings in overhead.....		3,000
Total savings in operating costs.....		\$5,000
Less: Loss on old machine.....	\$5,000	
Installation of new machine.....	600	
Total.....	\$5,600	
Per annum.....		560
Total estimated annual cost savings...		<u>\$4,440</u>

$$\text{Pay-off } \frac{10,000}{4,400} = 2.3 \text{ years}$$

$$\text{Return on investment } \frac{4,440}{10,000} = 44.4\%$$

Required: Evaluate the data submitted.

- 18-12 *Determining optimum economic life.* The Easy Ride Taxi Company has franchises in several large cities along the East Coast. It operates in excess of 2,000 taxicabs. The president has requested that you inform him as to the optimum number of years to operate the average taxi before trading it in for a new one. The company uses a 10 percent rate for the cost of capital for investments of this type. Your study reveals that the company has been purchasing new cabs at \$3,200 and that trade-in values and operating and maintenance costs are as follows:

Year	End of year trade-in value	Total annual operating and maintenance costs
1	\$2,400	\$ 480
2	1,700	540
3	1,100	640
4	700	760
5	300	1,040
6	100	1,360

- 18-13** *Methods for calculating return on investment.* The Tasty Tea Corporation is considering buying a new blending machine. The blender will cost \$50,000 and will have an estimated 10-year life and an annual income of \$10,000 after taxes but before depreciation.

*Required:*

1. Calculate the return on investment, using original investment, average investment, and the discounted cash flow method.
2. Evaluate each of these methods.
3. Prove that the discounted cash flow method provides for capital recovery.

- 18-14** *Investment in salesmen's cars.* The Fine Food Company maintains a large sales force. Each salesman is required to use his own car for traveling and is reimbursed by the company at 10 cents per mile traveled. The company also pays for all car insurance. The cars average 22,000 miles a year.

The company is considering the following two alternative plans:

1. The company will purchase and maintain its own fleet of cars. Under this plan, the cost of each car will be \$3,600, and it will have a 3-year life. Average annual operating costs are estimated as follows:

Gasoline and oil.....	\$0.0227 per mile
Repairs and maintenance.....	\$0.0068 per mile
Tires and parts.....	\$0.0055 per mile
Insurance.....	\$110 per annum
Depreciation.....	\$1,200 per annum
License.....	\$20 per annum

2. The company will lease the cars at an annual cost of \$1,700 per car. Under this plan, the lessor will pay for repairs and maintenance, insurance, and licenses.

*Required:* Assuming that the company's aftertax cost of capital is 7 percent and that a 50 percent tax rate applies, which plan should the company approve?

- 18-15** *Investment in delivery fleet.* Lacy's Department Store maintains a large fleet of trucks to make deliveries to its customers. The company recently has had a study made which concluded that the optimum time period to retain a truck was 5 years. This was based on the assumption that the average truck would continue to travel 20,000 miles a year and that during the 5-year period a truck's cost would be as follows:

Investment.....	\$6,400
Salvage value (end of 5th year).....	500
Annual operating costs:	

Year	Drivers' salaries and fringe benefits	Gas and oil (per mile)	Repairs and miscellaneous
1	\$6,200	\$ .04	\$ 900
2	6,200	.04	1,100
3	6,200	.045	1,500
4	6,200	.045	1,800
5	6,200	.05	2,100

Acme Parcel Company, which satisfactorily serves a number of other stores in the city, has offered to provide the same service at \$10,400 per truck per year. Lacy's pretax cost of capital has been calculated at 15 percent.

*Required:* Should Lacy's continue to operate its own fleet of trucks, or should it accept Acme's offer?

- 18-16** *Choosing between alternative investments.* The Forbes Steel Corporation has \$2,000,000 available for its equipment modernization program. These funds can be invested in several alternative machines, with equal risk. Of the various potential investments, machine A and machine B will yield the highest returns. The pertinent data applicable to these two machines are as follows:

	<i>Machine A</i>	<i>Machine B</i>
Initial outlay .....	\$1,000,000	\$2,000,000
Average annual cash savings .....	\$573,500	\$802,200
Economic life .....	5 years	10 years

If machine A is purchased, it is possible to invest the additional \$1,000,000 in other machinery with the same risk, but having a return of only 17 percent after taxes. The company uses the sum-of-the-years-digits method for calculating depreciation and pays income taxes at a rate of 54 percent.

*Required:* How should the company invest the \$2,000,000 so as to maximize its return? (Based on material furnished by Socony Mobil Oil Company, Inc.)

- 18-17** *Decision to invest in oil wells.* Oil Enterprises, Inc., owns or leases a number of small and medium-sized oil fields throughout North and South America. The company does not engage in oil exploration but attempts to develop and produce oil from established sources. During the year 1962 its earnings after taxes amounted to \$9,000,000. Its balance sheet, prepared at the close of 1962, is presented in condensed form in Exhibit I.

The company has an opportunity to purchase certain oil wells already in existence. It is estimated that in each of the 5 succeeding years these wells will produce 60,000, 60,000, 50,000, 30,000, and 20,000 barrels of crude oil. The price of the property, including existing equipment, is \$185,000, to be paid at the signing of the contract, plus an annual royalty of 50 cents a barrel produced.

It is believed that the company will be able to obtain \$3 per barrel for crude produced during the next 5 years. Depreciation and depletion are estimated at 50 cents a barrel. However, for tax purposes an additional depletion allowance equal to 10 cents per barrel will be allowed as a deduction. Fixed cash costs are expected to be \$15,000 a year and variable costs 80 cents a barrel.

## Exhibit I

OIL ENTERPRISES, INC.  
Condensed Balance Sheet  
As at December 31, 1962

<i>Assets</i>	
Current assets.....	\$150,000,000
Fixed assets.....	140,000,000
Other assets.....	10,000,000
Total assets.....	<u>\$300,000,000</u>
<i>Liabilities</i>	
Current liabilities.....	\$ 60,000,000
Long-term indebtedness	
20-year 3% debentures.....	\$40,000,000
4% 3-year notes.....	10,000,000
Total liabilities.....	<u>\$110,000,000</u>
<i>Stockholders' equity</i>	
5% preferred—outstanding 400,000 shares, par \$100 (market value \$110).....	\$ 40,000,000
Common—outstanding 600,000 shares, par \$100 (market value \$150).....	60,000,000
Earned surplus.....	90,000,000
Total stockholders' equity.....	<u>\$190,000,000</u>
Total liabilities and stockholders' equity.....	<u>\$300,000,000</u>

*Required:* Should the company make the investment? The company calculates the cost of its capital derived from retained earnings in the same manner as from common stock. Income taxes are calculated at 50 percent.

- 18-18** *Lease or buy.* A large national corporation which has been renting its electronic data-processing equipment is now contemplating the purchase of the same units. The monthly rental fee per unit is indicated in Exhibit I. The rental contract provides for maintenance service without additional charge. If the same units are purchased, in addition to the purchase price, maintenance charges would amount to \$46,400 during the first 3 years, \$54,800 for the next 3 years, and \$65,800 for the last 3 years. The manufacturer will not contract for maintenance service on equipment older than 9 years. The company therefore estimates the life of purchased units at 9 years. The company's cost of capital, after taxes, is 6.5 percent, and its income tax rate averages 50 percent of net income. The company uses a straight-line depreciation method. Although the equipment is not expected to have any resale value at the end of 9 years, for tax purposes the Treasury Department requires that depreciation be spread over 16 years.

*Required:*

1. Should the company purchase these units?
2. What nonquantitative factors are important in a decision of this type?

Exhibit I

Unit	Monthly rental per unit	Number of units required	Total rental cost	Purchase price
Key punch.....	\$ 10	2	\$ 20	\$ 1,000
Key punch.....	40	34	1,360	68,000
Printing card punch.....	60	1	60	3,000
Verifier.....	50	10	500	25,000
Sorter.....	110	2	220	11,000
Sorter.....	250	3	750	37,500
Collator.....	215	2	430	21,500
Card proving unit.....	612.50	1	613	30,650
Alpha accounting machine.....	800	4	3,200	200,000
Reproducing punch.....	133	5	665	33,250
Computing punch.....	163	1	163	6,900
Gang summary punch.....	85	2	170	8,500
Cardatype punch.....	55	1	55	2,750
Alpha interpreter.....	185	2	370	18,500
Electric calculator.....	460	1	460	19,000
Magnetic-tape unit.....	700	9	6,300	279,000
Output typewriter.....	45	1	45	2,250
Facsimile posting machine.....	35	1	35	1,750
Computer processing unit.....	3,235	3	9,705	451,300
Card reader punch.....	550	3	1,650	74,400
Printer.....	775	3	2,325	92,400
			<u>\$29,096</u>	<u>\$1,387,650</u>

18-19 *Investment in product improvement program.* The Union Wallboard Company manufactures and sells unpainted wallboard at a price of \$205 per thousand square feet, on which its contribution margin is \$23.50 per thousand square feet.

Several competitors of the Union Wallboard Company recently have introduced competing wallboard, which is being prime-painted at their factories. Union's product manager has requested that facilities be provided to prime-paint its wallboard, so that the company may retain its share of the market. On the basis of a market survey, the product manager has estimated the company's sales for the next 10 years and the lost sales if the company fails to prime-paint its product. This is shown in Exhibit I.

The controller estimates that variable working capital amounts to approximately 30 percent of sales, and the production engineer estimates that the additional facilities required to prime-paint are as follows (all such equipment will have 10-year lives):

1. Roller-coating unit for paint application, 50-ft drying oven, 25-ft cooling section..... \$50,000
2. Taper stacker to prevent damage to painted sheet.... 15,000
3. Dustproof conditioners..... 10,000



*Exhibit I*

UNION WALLBOARD COMPANY  
Product Manager's Estimate of Sales  
(In thousands of square feet)

<i>Year</i>	<i>Forecast sales of prime-painted wallboard</i>	<i>Forecast lost sales if wallboard is not painted</i>
1	2,400	1,300
2	2,800	1,600
3	3,200	1,900
4	3,500	2,200
5	3,800	2,500
6	4,100	2,800
7	4,400	3,100
8	4,600	3,300
9	4,800	3,500
10	5,000	3,700

The painting operation can be installed in a few weeks. It would occupy space at present used by a tenant who pays \$2,000 a year rent. The company has not decided whether or not to renew the lease, which has just expired.

The product manager states that the competitive price of prime-painted wallboard would be \$15 per thousand square feet higher than that of the present unpainted product. Incremental factory materials, labor, and overhead resulting from the painting operation are calculated at \$13.50 per thousand square feet. In addition, added cash discounts to customers would be 30 cents and selling and administrative expenses 70 cents per thousand square feet.

The company's management is willing to undertake the investment provided that a pretax return on investment is obtained of at least 20 percent.

*Required:* Using the present-value method, calculate whether or not the company should undertake the investment.

## 19. **Distribution Cost Analysis**

In the evolution of cost accounting in the United States, major attention has been given to the measurement, control, and reporting of production costs. Distribution costs and administration costs have not been accorded such emphasis either by management or in the literature of accounting until more recent years.

Perhaps the major obstacle to the designing of a distribution cost data accumulation scheme for management planning and decision-making purposes is the lack of a single, uniform factor with which distribution costs vary or are directly related. A second complicating fact is that at the time when a distribution cost is incurred, it is impossible to anticipate the classification which may be necessary for any particular plan or decision alternative, since there may be an infinite number of possible plans and decisions.

In addition, distribution cost relationships change as marketing strategies change and as distribution and promotional programs are adopted or changed. Once a particular program or strategy is adopted, many distribution costs become fixed or sunk costs rather than costs which are direct or variable with respect to any particular factor. The appropriate data for any accounting analysis depends upon the purpose of the analysis and the point in time at which the analysis is made.

For planning and decision-making purposes, therefore, special studies, rather than continuous day-to-day classification and recording of cost relationships, may be the most plausible method of accounting in the distribution cost area.

### **Nature of the distribution function**

The distribution function may be defined broadly as the task of getting the manufactured product to the firm's customer in return for the agreed monetary remuneration. So defined, the distribution function includes both marketing and transportation. For cost measurement and control purposes, the total distribution function may be divided into the functions of:

1. Demand creation and demand sustaining (advertising and sales promotion)

2. Storage and warehousing
3. Transportation
4. Customer financing and collection

Costs in function 1 often are called *order-getting costs*; those in 2, 3, and 4 are known as *order-filling costs*. Within the firm, this division frequently is the basis for organization and the assignment of responsibility.

### Nature of distribution costs

The reader should recall that production costs may be recorded by object of expenditure and also by department or function for control purposes. All production costs eventually are assigned to production output on some orderly basis for purposes of inventory costing and income determination.

Distribution costs conventionally are not inventoriable costs; i.e., they are not assumed to attach to product for income determination purposes. Rather, these costs are assigned to the period in which they are incurred and therefore are commonly referred to as expenses, or period expenses. In this respect, the accounting for distribution costs is less complex than accounting for production costs.

For management control purposes, standard or normal distribution cost rates may be developed for each of the functions of distribution when the organizational arrangement of the firm is on a functional basis. Frequently this is not the case, and management controls are more difficult to administer. Responsibility accounting, which requires organization along functional departmental lines, may thus be less easily implemented in the distribution area.

Most distribution costs are indirect and nonvariable with respect to total sales activity. Since generally only direct and variable costs are considered controllable, control through departmentalization, in a manner similar to that in production cost control, is somewhat hampered in the area of distribution costs.

There is a fundamental distinction between production costs and distribution costs. In production, once the products to be manufactured have been determined, the goal is efficiency and reduced production cost per unit of product. In other words, efforts are directed toward cost minimization within certain quality standards. In marketing and distribution, on the other hand, the relationship of distribution costs to sales dollars is of prime importance. The goal is not distribution cost minimization but rather tends to be profit maximization, or at least profit maintenance and enhancement. Neither, under selective selling, is the goal that of sales volume maximization, contrary to the prevalent and strong assumption of many sales managers.

### Refinements in distribution cost accounting and control

The degree of refinement in accounting for and controlling distribution costs varies in business practice. The simplest, and perhaps crudest,

method is that in which normal or standard distribution cost allowances are based upon a fixed percent of sales. For example, 30 percent of sales revenue may be established as the distribution cost allowance. This percent may be broken down into a certain percent for each of five or six functions of distribution. In some cases, such as advertising in particular, a fixed dollar allowance or appropriation may be established, with allowances for other functional classifications based upon a percent of sales.

A further refinement is found in the technique of classifying sales by product, territory, or distribution outlet and establishing allowances for total distribution expenses or for each of the functional distribution groupings. For example, on the basis of study and analysis, a normal distribution cost allowance may amount to 40 percent of sales of product A and 28 percent of sales of product B. Or a normal transportation cost allowance may be set at 10 percent of sales in area X and 30 percent of sales in area Y. Or perhaps a normal advertising allowance may be 40 percent of direct-mail sales and 10 percent of retail outlet sales.

A third technique is to classify all individual or functional groups of distribution costs according to their direct relationship or variation with specific factors of variability. This involves a substantial amount of study and analysis. The results of such efforts, however, are useful both for planning and control.

Typically, for planning and decision making, production costs may be classified according to their directness or indirectness with respect to

### Exhibit 19-1

#### A.B.C. CORPORATION Time Standards Billing

Operation	Time per invoice, min
1. Select order and position.....	.11
2. Select blank invoice and position.....	.19
3. Type face of invoice.....	.28
4. Type body of invoice.....	.91*
5. Clear machine.....	.05
6. Select envelope and position.....	.09
7. Type envelope.....	.28
8. Clear machine.....	.05
9. Allowance for erasures, corrections, and ribbon changes.....	.21
Total studied time.....	2.17
Personal habits, fatigue, etc.....	.33
Standard time allowance per invoice.....	2.50

\* Based on average invoice size.

product and their variability with production volume. Volume is the important factor of variability in decisions involving the fixed and variable nature of costs and the relevance of costs for a proposal or plan.

In distribution costing, however, there are many factors of variability with regard to which it may be important to know the directness or indirectness of particular distribution costs, depending upon the particular purpose for which an analysis is made. In other words, many distribution costs vary with factors other than total sales volume itself. This is illustrated in Exhibits 19-1 and 19-2.

Exhibit 19-1 shows how engineered standards might be established to control billing costs. This type of standard generally has applicability only in activities that are largely repetitive and involve a sizable work force. Engineered standards have been used in such activities as billing, packing, shipping, warehouse receiving, and truck deliveries.

There are limitations to the use of engineered standards in the distribution field. First, distribution activities tend to vary to a considerably greater extent than in the factory. Invoices and orders differ in amount. The size, weight, and location of units to be shipped affect the shipping time per order. Deliveries and delivery routes rarely are sufficiently standardized to warrant the employment of time standards. Second, the

### Exhibit 19-2

#### THE BATES COMPANY Variable Budget Midwestern Warehouse Year Ended December 31, 1963

Units received or shipped Invoices billed		500,000 50,000	550,000 55,000	600,000 60,000	650,000 65,000	700,000 70,000	750,000 75,000
Warehouse expenses	Variable base						
Salaries:							
Supervision	Fixed	\$ 13,000	\$ 13,000	\$ 13,000	\$ 13,000	\$ 13,000	\$ 13,000
Office	Fixed	28,000	28,000	28,000	28,000	28,000	28,000
Receiving	Units received	33,000	33,000	37,000	37,000	41,000	41,000
Materials moving	Units received	40,000	43,000	46,000	49,000	52,000	55,000
Order packing	Units shipped	56,000	64,000	72,000	80,000	88,000	96,000
Packing	Units shipped	32,000	35,000	38,000	41,000	44,000	47,000
Loading	Units shipped	26,000	29,000	32,000	35,000	38,000	41,000
Billing	Invoices billed	24,000	24,000	27,000	27,000	30,000	30,000
Maintenance	Fixed	28,000	28,000	28,000	28,000	28,000	28,000
Postage	Invoices billed	1,000	1,100	1,200	1,300	1,400	1,500
Packing materials	Units shipped	75,000	82,500	90,000	97,500	105,000	112,500
Warehouse supplies	Fixed	38,000	38,000	38,000	38,000	38,000	38,000
Office supplies	Invoices billed	6,200	6,400	6,600	6,800	7,000	7,200
Depreciation	Fixed	35,000	35,000	35,000	35,000	35,000	35,000
Taxes and insurance	Fixed	9,000	9,000	9,000	9,000	9,000	9,000
Utilities	Fixed	11,000	11,000	11,000	11,000	11,000	11,000
Total		\$455,200	\$480,000	\$511,800	\$536,600	\$568,400	\$593,200



measurement of a single activity may require several different bases for measurement. Third, determining the factor of measurement may be difficult, e.g., invoice lines billed, units of different sizes and weights packed. Fourth, the establishment of engineered standards in the distribution area are apt to be resisted to a greater extent than in the factory, where the tradition of standards has been established longer.

Exhibit 19-2 presents a variable budget for the Midwestern warehouse of the Bates Company. The variable budget allowance is perhaps a more common type of distribution standard, since it relates to the company's profit plan. The variable budget is based on past experience adjusted for expected trends.

Presumably, the Bates Company will adjust the variable warehouse expenses to the actual activity level and then compare the adjusted budget allowances with the actual expenses. This method has serious limitations as a basis for cost control. The indices of measurement do not always provide a sufficiently precise guide to actual expenditures, particularly in month-to-month comparisons. The guidelines generally are too broad. For example, the mix of units received or shipped affects the level of receiving and shipping salaries.

### Distribution cost applications

In the remainder of this chapter, a series of case illustrations will be presented involving the use of specific costs for selected distribution decisions. The following will be considered:

1. Product-line evaluation
2. Order size profitability
3. Delivery route decisions
4. Selecting among alternative channels of distribution
5. Determining the optimum number of salesmen

### *Product-line evaluation*

In evaluating a product or product line, many factors must be considered, including growth trend, competition, profitability, and capital employed. Product profitability statements are a major source of information. They indicate products which should be pushed or eliminated and suggest areas of cost reduction. Product profitability statements are indispensable in pricing decisions. They serve as a guide to establishing salesman incentives. Yet, a considerable number of businesses do not prepare product profitability statements. To a large extent, this condition prevails among concerns that do not maintain cost accounting systems.

Even among companies that utilize cost accounting, the manner and frequency of preparation of product profitability statements vary greatly. Many companies prepare statements only for product lines, rather than for individual products. Some companies prepare product reports at regular time intervals—monthly, quarterly, or annually; others do so only spasmodically. Some firms prepare product statements which include allocated selling and administrative expenses and variances from standard; others compute only gross profit and contribution margins. Some companies show only return on sales; others also give effect to return on investment.

### Illustration of product-line evaluation

The Mohawk Company conducts an annual review of the profitability of its product lines. The pertinent data reported to management appear in Exhibits 19-3 and 19-4. In Exhibit 19-3 only the direct revenue, costs, and capital investment are included.

After receiving copies of Exhibits 19-3 and 19-4, each product-line manager is required to prepare a report encompassing the answers to the questionnaire appearing in Exhibit 19-5. The report is accompanied by a 1-year and 5-year projection of product-line profitability similar in form to Exhibit 19-3.

#### Exhibit 19-3

#### THE MOHAWK COMPANY Profitability Analysis—Product Line 1 For the Years Ended December 31, 1962 and 1963

	1962	1963
Units produced.....	50,000	42,000
Unsold units—end of year.....	4,500	10,500
Units sold.....	47,500	36,000
Average unit price.....	\$80	\$100
Sales.....	\$3,800,000	\$3,600,000
Market potential achieved.....	29.0%	27.4%
Variable selling costs.....	\$760,000	\$730,000
Variable factory costs.....	\$1,210,000	\$1,150,000
Contribution margin.....	\$1,830,000	\$1,720,000
Contribution ratio.....	48.1%	47.8%
Direct fixed costs.....	\$590,000	\$600,000
Direct product-line profit.....	\$1,240,000	\$1,120,000
Direct profit on sales.....	32.6%	31.1%
Direct break-even point.....	\$1,226,600	\$1,255,200
Direct-capital investment.....	\$980,000	\$940,000
Direct return on direct investment....	126.5%	119.2%
Turnover of direct investment.....	3.88	3.83

## Exhibit 19-4

**THE MOHAWK COMPANY**  
**Causes of Changes in Profitability—Product Line 1**  
**1963 in Comparison with 1962**

**Changes in direct-product profitability:**

(1) Due to decrease in total market.....	\$ -751,840
(2) Due to decrease in share of market.....	-168,160
(3) Due to increase in average price.....	+720,000
(4) Expected decrease in variable selling costs due to decline in volume.....	+184,000
(5) Increase in variable selling costs due to increase in selling costs per unit.....	-154,000
(6) Expected decrease in variable factory costs due to decline in production level.....	+193,600
(7) Increase in variable factory costs due to increase in cost per unit produced:	
Raw materials prices.....	\$ -110,800
Raw materials utilization.....	+ 30,200
Direct-labor rate.....	-165,000
Direct-labor efficiency.....	+ 80,000
Variable factory overhead.....	+ 32,000
	<u>-133,600</u>
Change in contribution margin.....	\$ -110,000
(8) Due to increase in direct fixed costs.....	- 10,000
Decrease in direct-product profit.....	<u>\$ -120,000</u>

**Changes in direct return on direct investment:**

(9) Due to decrease in return on sales.....	-5.7%
(10) Due to decrease in turnover of investment.....	-1.6
Change in direct return on direct investment.....	<u>-7.3%</u>

The computations supporting the data appearing in Exhibit 19-4 follow:

**(1) Decrease in total market:**

Total market—1962 (47,500/.29), units.....	163,793
Total market—1963 (36,000/.274), units.....	131,387
Decrease in total market, units.....	32,406
Product line's share of market—1962.....	× .29
Product line's share of total market decline, units.....	9,398
Average price—1962.....	× \$80
	<u>\$751,840</u>

**(2) Decrease in share of market:**

Total market—1963, units (item 1 above).....	131,387
Decline in percent of market obtained (.29 - .274).....	× .016
Units lost because of decline in share of market.....	2,102
Average price—1962.....	× \$80
	<u>\$168,160</u>

(3) Price increase:	
Units sold—1963.....	36,000
Average price increase per unit (\$100 - \$80).....	×\$20
	<u>\$720,000</u>
(4) Decrease in variable selling costs due to decline in volume:	
Variable selling costs per unit sold—1962 (\$760,000/47,500)	\$16
Fewer units sold—1963 (47,500 - 36,000).....	×11,500
	<u>\$184,000</u>
(5) Increase in variable selling costs due to increase in variable selling costs per unit sold:	
Variable selling costs per unit sold—1962 (\$760,000/47,500)	\$16.000
Variable selling costs per unit sold—1963 (\$730,000/36,000)	\$20.277
Increase in variable selling costs per unit sold—1963.....	\$4.277
Units sold—1963.....	×36,000
	<u>\$154,000</u>
(6) Decrease in variable factory costs due to decline in production level:	
Variable factory cost per unit produced—1962 (\$1,210,000/50,000).....	\$24.20
Fewer units produced in 1963 (50,000 - 42,000).....	×8,000
	<u>\$193,600</u>
(7) Increase in variable factory costs per unit produced:	
Variable factory cost per unit produced—1962 (\$1,210,000/50,000).....	\$24.200
Variable factory cost per unit produced—1963 (\$1,150,000/42,000).....	27.381
Increase in variable factory cost per unit.....	\$3.181
Units produced—1963.....	×42,000
	<u>\$133,600</u>
(8) Increase in direct fixed costs:	
Direct fixed costs—1963.....	\$600,000
Direct fixed costs—1962.....	\$590,000
	<u>\$ 10,000</u>
(9) Decrease in direct return on direct investment due to decrease in return on sales:	
Direct return on sales—1962.....	32.6%
Direct return on sales—1963.....	31.1%
Decrease in direct return on sales.....	1.5%
Turnover of capital—1963.....	×3.83
	<u>5.7%</u>
(10) Decrease in direct return on direct investment due to decrease in turnover of investment:	
Turnover of direct investment—1962.....	3.88%
Turnover of direct investment—1963.....	3.83%
Decline in turnover of investment.....	.05%
Direct return on sales—1963.....	×31.1
	<u>1.6%</u>

*Exhibit 19-5*

**THE MOHAWK COMPANY**  
Questionnaire for Product-line Analysis

1. What factors caused the increase or decrease in total market? Will this trend continue during the coming year? The next 5 years?
2. What are the causes of the increase or decrease in the product line's share of market (new competition, selling and promotion, design changes, etc.)? Will this trend continue next year? During the next 5 years? What steps are you planning to increase the share of market?
3. As a consequence of the answers to questions 1 and 2, what changes in facility requirements are planned for the coming year? The next 5 years? Show estimated return on all major capital additions.
4. Are any major price changes planned for the coming year? If so, what are the reasons? What effect do you think this will have on the number of units sold?
5. If variable selling costs per unit have increased, indicate the reasons. Do you expect them to continue to increase in the coming year? The next 5 years?
6. If variable factory costs per unit have increased, indicate the reasons. Do you expect them to continue to increase in the coming year? The next 5 years?
7. Consolidate your answers to the foregoing questions, and prepare a profit projection for the product line for the coming year and for the next 5 years. Show the expected direct return on direct investment.

*Order size profitability*

Small orders are less profitable than large orders, because costs do not rise proportionately to increases in the size of orders. Certain costs remain relatively constant regardless of the order size. Other costs rise with increases in order size but at a decreasing rate. Thus, the cost per unit shipped decreases with increases in the size of the order.

The seriousness of the small-order problem is evidenced by the results of a study conducted by the National Industrial Conference Board:<sup>1</sup>

This study of the experience of 254 companies shows that the problem of filling small orders is widespread in industry. It is faced not only by manufacturers of small, inexpensive products but also by producers of bulk commodities or heavy equipment to whom an order worth several hundred dollars might be considered "small" and result in an operational loss.

Small orders occur for a variety of reasons. The study of the National Industrial Conference Board lists the following types:<sup>2</sup>

<sup>1</sup> *Small Orders: Problems and Solutions*, Studies in Business Policy, no. 94, National Industrial Conference Board, p. 5.

<sup>2</sup> *Ibid.*, pp. 6, 7.



1. The repair part—maintenance parts required in conjunction with equipment sales.
2. The emergency order—a customer who is faced with an unexpected and critical need.
3. Oversight orders—small items omitted by oversight from a previous order.
4. Fill-in orders—orders required to fill in and balance customers' stock.
5. Hand-to-mouth buying—orders arising from lack of inventory control or poor buying habits of customers.
6. Drop shipments—small shipments made for the convenience of a middleman directly to his customer.
7. The small account—small accounts will have a tendency to submit proportionately smaller orders.
8. Trial orders—small orders requested by customers to test the saleability of a product.

### Procedure for analyzing order size profitability

In attempting to measure order size profitability, it is first necessary to establish the order size classifications. This will vary in different companies, since a large order for one company may be a small one for another. Perhaps the most logical method for establishing the order size categories is to make a statistical sampling of invoices. This will reveal a pattern for setting up the order size ranges. It is then necessary to determine the total sales in each order size. This can be accomplished by using the same sample data. Thus, if 500 invoices, selected at random, are regarded as representing an adequate sample, these invoices may be used as the basis for establishing the amount of total sales which fall within each order size.

After the total sales have been divided according to order size, it is necessary to associate relevant costs with the order size. Only those costs which relate directly to the size of orders are pertinent. They may include certain fixed as well as variable costs. If by eliminating the small orders it is possible to reduce the number of delivery trucks used, the cost of these trucks becomes a relevant cost. If on the other hand, the space occupied by the credit department will not be affected by the elimination of small orders, these costs are not relevant.

### Illustration of order size analysis

The Elégante Hosiery Company's plant and main office are located in New York City. Local deliveries to customers are made in company-owned trucks. Hosiery sold outside the New York area is shipped by common carrier, and transportation costs are prepaid. In January, 1963, the company's president requested that a study be made of the firm's profitability by order size.

During 1962, the company's sales amounted to \$6.5 million, on which a profit of \$536,000, or 8.2 percent of sales, was earned. Tests indicated

Exhibit 19-6

ELEGANTE HOSIERY COMPANY

Order Size Profitability

January 1, 1962, to December 31, 1962

	Total		Basis of allocation	Less than \$100		\$101-\$300		\$301-\$500		\$501-\$700		\$701-\$900		Over \$900	
	Amount	Per-cent of sales		Amount	Per-cent of sales	Amount	Per-cent of sales	Amount	Per-cent of sales	Amount	Per-cent of sales	Amount	Per-cent of sales	Amount	Per-cent of sales
Sales.....	\$6,500,000	100.0		\$300,000	100.0	\$500,000	100.0	\$1,000,000	100.0	\$1,800,000	100.0	\$1,700,000	100.0	\$1,200,000	100.0
Less:															
Direct costs															
Materials.....	\$1,690,000	26.0	Direct	\$ 70,000	26.0	\$130,000	26.0	\$ 260,000	26.0	\$ 468,000	26.0	\$ 442,000	26.0	\$ 312,000	26.0
Direct labor.....	845,000	13.0	Direct	39,000	13.0	65,000	13.0	130,000	13.0	234,000	13.0	221,000	13.0	156,000	13.0
Variable factory overhead.....	422,500	6.5	Direct	19,500	6.5	32,500	6.5	65,000	6.5	117,000	6.5	110,500	6.5	78,000	6.5
Freight out.....	500,000	7.7	Average freight cost per order	40,000	13.3	60,000	12.0	75,000	7.5	125,000	6.9	120,000	7.1	80,000	6.7
Shipping salaries.....	40,000	.6	Time study	3,600	1.2	5,200	1.0	6,400	.6	10,000	.6	9,200	.5	5,600	.5
Local delivery: drivers' salaries (\$64,000), truck depreciation (\$25,000), gas and oil (\$11,000), repairs and maintenance (\$10,000), miscellaneous (\$7,000).....	117,000	1.8	Orders delivered	45,600	15.2	17,600	3.5	15,200	1.5	18,700	1.0	12,900	.8	7,000	.6
Selling: salaries (\$360,000), traveling (\$130,000).....	490,000	7.5	Total time—customer calls	67,600	22.6	127,400	25.5	85,300	8.5	81,800	4.5	85,300	5.0	42,600	3.5
Credit department: salaries (\$25,000), bad debts (\$31,000).....	56,000	.9	Time study and bad debt experience	13,600	4.5	9,000	1.8	9,500	1.0	11,000	.6	9,300	.5	3,600	.3
Order taking salaries.....	6,000	.1	Order sample	3,000	1.0	2,000	.4	1,000	.1	—	—	—	—	—	—
Billing salaries.....	30,000	.5	Billing lines	4,800	1.6	3,000	.6	3,800	.4	6,600	.4	6,700	.4	5,100	.4
Total.....	\$4,196,500	64.6		\$314,700	104.9	\$451,700	90.3	\$551,200	65.1	\$1,072,100	59.5	\$1,016,900	59.8	\$689,900	57.5
Direct profit or loss.....	\$2,303,500	35.4		\$ (14,700)	(4.9)	\$ 48,300	9.7	\$ 348,800	34.9	\$ 727,900	40.5	\$ 683,100	40.2	\$ 510,100	42.5

NOTE: In the Elegante Hosiery Company, the size of orders does not affect production costs, since items are made for stock. In a job-order plant, small order sizes may affect the factory cost per order.

that the product mix was essentially the same for both large and small orders. In the *Elégante Hosiery Company*, production costs are not affected by the size of orders, since products are made for stock. The results of the study appear in Exhibit 19-6.

Costs were assigned to the different order sizes as follows:

1. Freight costs were charged on the basis of freight rate differentials. Since freight rates vary with the weight of shipments, freight costs are proportionately higher for small orders.

2. Time studies were made of the personnel directly engaged in shipping. It was found that the time required to ship larger orders was greater than for smaller orders but that the time increased at a decreasing rate.

3. A study of the local delivery function disclosed that the major portion of the delivery time cycle was spent in transportation and that there was no significant difference in delivery time between large and small orders. Accordingly, delivery costs were assigned to order sizes on the basis of the number of orders delivered. As a result the small order sizes were charged with a proportionately larger share of these costs. If the distance traveled to deliver the smaller orders exceeded that of the larger orders, additional weight would have to be given to this factor. This might occur if the smaller orders were received primarily from small specialty shops located around the periphery of the city, whereas the larger orders were derived from centrally located department stores.

4. Salesmen were required to submit a recapitulation of the number of customers visited, the frequency of the calls, and the estimated time spent per call. These data together with an analysis of the size of orders submitted by each customer provided a basis for allocating salesmen's costs to the different order sizes.

5. Time studies showed that the credit department activity varied with the number of orders processed and the credit risk involved. A proportionately greater share of the credit department salaries was charged against the 0-to-\$100 and \$101-to-\$300 order sizes because of the greater number of orders and the poorer credit status of these customers.

6. The order-taking costs represented the salaries of two clerks who received telephone orders. These costs were allocated on the basis of a sampling of orders received.

7. The salaries of the billing clerks were distributed to the order size categories on the basis of the total invoice lines billed.

### **Alternative possibilities resulting from order size analysis**

When the results of a study of order size profitability produce a pattern similar to that in Exhibit 19-6, a company is confronted with several alternative possibilities for profit improvement. Can the cost of processing small orders be reduced? Should price differentials be established according to order size? Should small unprofitable orders be eliminated?

A study of order size profitability should suggest possibilities for cost reduction. Credit department costs, including losses from bad debts,

generally are disproportionately greater for small orders. This can be averted by requiring cash payments for all orders below a stipulated minimum. Selling costs can be reduced by eliminating salesmen's calls on customers who habitually submit unprofitable size orders.

If freight differentials are a major cost element, it might prove more economical to handle small orders through regional distributors, to whom goods can be shipped in carload lots. Packaging costs often can be reduced on small orders. Glove, hosiery, or tie companies that normally box their products may find it advantageous to replace the box with a less expensive paper sack for small orders.

Billing costs might be eliminated by posting to the small-order customer's account directly from the order. While the customer would not receive an invoice, the charge would appear on his monthly statement. The processing cost of small orders also sometimes can be reduced by establishing a separate department to handle such business.

One of the commonest methods for coping with unprofitable small orders is through price differentials. Companies that resort to price differentials should make certain that their actions are in compliance with the Robinson-Patman Act. This statute imposes heavy penalties on concerns which discriminate on prices among different purchasers, provided the goods are of a like grade and quality and the effect of such discrimination is substantially to lessen competition or to create a monopoly. It is permissible under the Robinson-Patman Act to establish price differentials which are based on traceable differences in the cost of manufacture, sale, or delivery of products. Price differentials may assume the form of penalties or service charges on small orders or the granting of quantity discounts on large orders. From a psychological standpoint, the latter method is preferable.

A company that cannot reduce the cost of small orders sufficiently to make them attractive or that does not feel that it is advantageous to institute a system of price differentials inevitably will be faced with a decision as to whether it would be more profitable to eliminate the small-order business entirely.

It is apparent from Exhibit 19-6 that the Elégante Company is sustaining an out-of-pocket loss on orders of less than \$100 in the amount of \$14,700. The elimination of this order size would therefore increase the company's profits. However, before discontinuing these orders, consideration should be given to other factors such as these: What effect will the elimination of these small orders have on large orders, particularly if the small orders consist largely of parts or fill-ins? What are the growth possibilities among small-order customers?

### *Delivery route decisions*

In many industries, it is customary to deliver products to customers in company-owned trucks. Where this occurs, delivery costs often represent



a sizeable portion of the total cost of products sold and should be controlled carefully. Proper cost control requires the segregation of all costs directly related to delivery routes. Certain of these costs, such as truck depreciation, insurance, and garage space, are fixed. Other costs, such as gas and oil, repairs, maintenance, and drivers' commissions, are variable. If a large fleet of trucks is maintained, it may be desirable to establish predetermined standards. Truck cost standards can be established in terms of truck miles. Loading and unloading standards can be based on the number of units delivered.

Route profit and loss statements are useful. They suggest cost reduction or other possibilities for profit improvement. These statements should disclose the revenue earned on each route less variable factory costs. Itemized route costs should then be deducted to yield the direct route profit.

### Illustrative example of route decisions

The Glendale Dairy Company operates a plant in the city of Harristown. The company serves a population of 50,000. Its sales territory is divided into six milk routes and one ice cream route. Related products such as sour cream, coffee cream, and buttermilk are sold on the milk routes. Routes 1 and 2 cover the central part of Harristown. Sales on route 1 are made exclusively to stores at a price which is 2 cents less than to house customers. Sales on route 2 are made to schools and hospitals, as well as to stores. Schools and hospitals are granted a special discount. Sales on routes 3 to 6 are primarily to house customers, although some sales also are made to schools and factories. Smaller trucks are used for house deliveries than for store deliveries. The customers on routes 3 to 6 primarily are located in the suburbs of the city. Route 7 consists exclusively of ice cream deliveries to stores. A special refrigerated

### Exhibit 19-7

GLENDAL DAIRY COMPANY  
Route Sales for the 5 Years Ended December 31, 1962

Route	1958	1959	1960	1961	1962
Route 1.....	\$130,000	\$134,400	\$141,200	\$146,000	\$150,800
Route 2.....	118,100	120,000	123,200	125,400	127,400
Route 3.....	49,000	49,200	49,700	50,100	50,400
Route 4.....	35,000	35,700	35,500	36,000	36,400
Route 5.....	50,100	50,800	52,300	54,600	56,000
Route 6.....	49,500	49,700	54,200	56,400	58,800
Route 7.....	158,000	163,400	167,100	168,600	170,000
Total.....	\$589,700	\$603,200	\$623,200	\$637,100	\$649,800
Percent of 1958.....	100.0	102.3	105.7	108.1	110.2



## Exhibit 19-8

**GLENDALE DAIRY COMPANY**  
**Route Profitability**  
**Year Ended December 31, 1962**

	Route 1	Route 2	Route 3	Route 4	Route 5	Route 6	Route 7	Total
Sales.....	\$150,800	\$127,400	\$50,400	\$36,400	\$56,000	\$58,800	\$170,000	\$649,800
Variable factory cost.....	100,800	94,200	29,800	24,300	36,000	37,100	117,000	439,200
Factory contribution margin....	\$ 50,000	\$ 33,200	\$20,600	\$12,100	\$20,000	\$21,700	\$ 53,000	\$210,600
Less: Route costs:								
Drivers' salaries.....	\$ 7,200	\$ 5,900	\$ 6,400	\$ 6,500	\$ 6,600	\$ 6,000	\$ 7,100	\$ 46,700
Payroll taxes, fringe benefits...	720	690	640	650	660	600	710	4,670
Depreciation.....	1,400	1,425	900	920	900	930	1,800	8,275
Repairs.....	200	175	150	130	160	170	300	1,285
Maintenance.....	230	210	140	140	150	150	250	1,270
Tires and other parts.....	125	150	125	120	140	130	150	940
Insurance.....	250	250	160	160	160	160	250	1,390
Gas and oil.....	750	700	800	780	820	810	750	5,410
Licenses, taxes and tolls.....	75	60	50	50	60	70	70	435
Garage costs.....	175	170	140	140	140	140	175	1,080
Miscellaneous.....	75	100	60	70	60	80	70	515
Total.....	\$ 11,200	\$ 10,830	\$ 9,565	\$ 9,660	\$ 9,850	\$ 9,240	\$ 11,625	\$ 71,970
Direct route profit.....	\$ 38,800	\$ 22,370	\$11,035	\$ 2,440	\$10,150	\$12,460	\$ 41,375	\$138,630
Less: Fixed factory, selling, and administrative costs.....								123,000
Net profit before taxes.....								\$ 15,630

truck is used for this route. The actual sales for the seven routes during the 5 years ended December 31, 1962, are shown in Exhibit 19-7.

At the close of the year 1962, a route profit and loss statement was prepared as shown in Exhibit 19-8. The company's profit was not considered satisfactory, and a study of the possibilities for profit improvement was undertaken.

The Glendale Dairy Company makes daily milk deliveries to its house customers. A market survey was initiated to determine what the effect on sales would be if house deliveries were made on alternate days. The results indicated that a loss of approximately 10 percent in volume could be expected, since not all house customers had sufficient refrigerator space to maintain a 2-day supply. Alternate-day deliveries would permit the combining of route 3 with route 5 and 4 with 6, with a resultant cost savings. The combining of these routes would necessitate the use of a larger delivery truck. It was estimated that the costs of a combined route would be about equal to the present costs of route 2, except for drivers' salaries (\$6,600).

Since this is a long-term decision, the discontinuance of a route results in a cost saving from the elimination of truck depreciation. No consideration was given to the interest saved on the reduction in investment in trucks, because the effect would be slight.

Exhibit 19-9 is a revised profitability statement for 1962 after giving consideration to alternate-day deliveries. On this basis, profits would have been \$25,505 instead of \$15,630, an increase of almost 65 percent.

## Exhibit 19-9

**GLENDALE DAIRY COMPANY**  
**Revised Route Profitability**  
**Year Ended December 31, 1962**

	Route 1	Route 2	Combined routes 4 and 6	Combined routes 3 and 5	Route 7	Total
Sales .....	\$150,800	\$127,400	\$85,680*	\$95,760*	\$170,000	\$629,640
Variable factory costs .....	100,800	94,200	55,260*	59,220*	117,000	426,480
Factory margin .....	\$ 50,000	\$ 33,200	\$30,420	\$36,540	\$ 53,000	\$203,160
Less: Route costs:						
Drivers' salaries .....	\$ 7,200	\$ 6,900	\$ 6,600	\$ 6,600	\$ 7,100	\$ 34,400
Payroll taxes, fringe benefits .....	720	690	660	660	710	3,440
Depreciation .....	1,400	1,425	1,425	1,425	1,800	7,475
Repairs .....	200	175	175	175	300	1,025
Maintenance .....	230	210	210	210	250	1,110
Tires and other parts .....	125	150	150	150	150	725
Insurance .....	250	250	250	250	250	1,250
Gas and oil .....	750	700	700	700	750	3,600
Licenses, taxes and tolls .....	75	60	60	60	70	325
Garage costs .....	175	170	170	170	175	860
Miscellaneous .....	75	100	100	100	70	445
Total .....	\$ 11,200	\$ 10,830	\$10,500	\$10,500	\$ 11,625	\$ 54,655
Direct route profit .....	\$ 38,800	\$ 22,370	\$19,920	\$26,040	\$ 41,375	\$148,505
Less: Fixed factory, selling and administrative costs .....						123,000
Net profit before taxes .....						\$ 25,505

\* Original data less 10%.

### Selecting among alternative channels of distribution

A manufacturing company may market its products in several different ways: It may employ its own salesmen. It may utilize the services of middlemen, such as wholesalers or commission merchants. It may establish its own retail outlets. It may even sell directly to the ultimate consumer by combining its factory and sales efforts at a single location as in the case of small factory loft operations in the clothing industry. Frequently, a company will employ two or more different marketing methods simultaneously. The selection of an appropriate channel of distribution constitutes an important marketing decision, since the final choice generally will have a significant impact on profits and growth.

A number of factors may affect the selection of a company's sales outlet, among which the following are perhaps most important:

1. Industry pattern. In industries where traditional channels of distribution exist, a company may have little choice but to conform to the existing pattern. Electric appliances customarily are sold through

regional distributors, who presumably are able to reduce selling costs by handling several noncompeting lines. Wearing apparel is normally sold directly to retail stores by the manufacturer's salesmen.

2. Financial status of the firm. Small firms cannot always afford the initial and continuing expenses of selling directly to customers, particularly if long periods of time are required to develop a satisfactory level of sales. Middlemen may perform services such as warehousing, billing, and credit collection, in addition to selling. Small companies, which may be pressed for liquid capital, may find it financially desirable to avoid sustaining these high costs.

3. Product characteristics. The nature of the products sold affects the selection of channels of distribution. Companies selling highly seasonal items may find it too costly to maintain a permanent selling staff. Firms that produce complicated products, whose sales require technical competence, wish to train their own sales force. Concerns selling small inexpensive items find it more profitable to sell through a distributor, who can carry several noncompeting lines.

4. Nature of the market. The nature of the market affects the selection of a company's sales outlets. If consumers are clustered, it may be more economical to sell to them directly. Other methods may be more expedient if customers are widely separated. When a company's personnel are unfamiliar with a market, as in the case of foreign sales, the utilization of an existing local channel of distribution is generally more advantageous.

5. Profitability. The relative profitability of alternative marketing channels is a basic consideration. Long-run profit projections are required, since a sales outlet cannot easily be eliminated once having been established. The profit forecast should show the volume, costs, and profits for the alternative channels. Volume is particularly important when excess capacity exists. Only those costs which vary with the alternative channels are relevant.

### **Illustration of the use of quantitative data in selecting among alternative channels of distribution**

The National Appliance Company manufactures three products which are sold throughout the country. The factory is located in Newark, New Jersey. Factory shipments are made to company-owned warehouses located in each of 20 sales districts. In addition to employing its own salesmen, almost half of the company's sales are made through distributors. All shipments, whether to distributors' customers or to salesmen's accounts, are made directly from company-owned warehouses. The company salesmen generally handle the larger accounts and also devote approximately 40 percent of their time to working with distributors and their customers. Distributors are granted a 20 percent discount in accordance with the prevailing industry practice. The distributors render no service other than selling.

## Exhibit 19-10

**THE NATIONAL APPLIANCE COMPANY**  
**Gross Profit on Distributor Sales—Cleveland District**  
**For the Year Ended December 31, 1962**

<i>Product</i>	<i>Units sold</i>	<i>Unit price*</i>	<i>Unit cost</i>	<i>Sales</i>	<i>Cost of sales</i>	<i>Gross profit</i>
A	40,000	\$ 8	\$ 7	\$320,000	\$280,000	\$ 40,000
B	20,000	12	10	240,000	200,000	40,000
C	5,000	16	12	80,000	60,000	20,000
	65,000			\$640,000	\$540,000	\$100,000

\* Net after 20% discount.

In January, 1963, the sales vice-president requested that a study be made which would show the effect on profits if the distributors were eliminated and all sales handled directly by company salesmen. The Cleveland district was selected as the test area. An analysis of the gross profit earned on distributors' sales for 1962 appears in Exhibit 19-10. The projection was to be made for the succeeding 5 years, from 1963 through 1967, and was to be based on 1962 selling prices, costs, and product mix. The company's market research department estimated that the following decline in sales could be anticipated as a consequence of eliminating distributors:

<i>Year</i>	<i>Units expected to be sold to distributors' customers by company salesmen</i>	<i>Percent of units shipped by distributors in 1962</i>
1963	32,500	50
1964	39,000	60
1965	48,750	75
1966	58,500	90
1967	65,000	100

The following additional data were obtained:

1. The aggregate costs of company salesmen, including compensation, traveling, entertainment, and gifts, were estimated at 15 percent of sales. Advertising and sales promotion costs were not expected to change.
2. Approximately 20 percent of the factory costs were fixed.
3. Variable costs at the Cleveland warehouse amounted to 80 cents per unit shipped.
4. During 1962, bad debts in the Cleveland district amounted to .5 percent of sales.
5. Transportation costs from the factory to the Cleveland warehouse



Exhibit 19-11

THE NATIONAL APPLIANCE COMPANY—CLEVELAND DISTRICT  
Calculation of the Economic Desirability of Replacing Distributor by Company Salesmen  
Projected for the 5 Years Ended December 31, 1967

	1963		1964		1965		1966		1967	
	Decrease in profits due to reduced revenue and added costs	Increase in profits due to increased revenue and reduced costs	Decrease in profits due to reduced revenue and added costs	Increase in profits due to increased revenue and reduced costs	Decrease in profits due to reduced revenue and added costs	Increase in profits due to increased revenue and reduced costs	Decrease in profits due to reduced revenue and added costs	Increase in profits due to increased revenue and reduced costs	Decrease in profits due to reduced revenue and added costs	Increase in profits due to increased revenue and reduced costs
(1) Loss in revenue.....	\$240,000		\$160,000		\$ 40,000		\$108,000		\$120,000	
(2) Added selling costs.....	60,000		72,000		90,000					
(3) Factory costs eliminated		\$216,000		\$172,800		\$108,000		\$ 80,000		\$160,000
(4) Warehouse costs										
eliminated.....		26,000		20,800		13,000		43,200		800
(5) Bad debts reduced.....		1,200		800		200		5,200		
(6) Transportation costs— factory to warehouse		16,250		13,000		8,125		3,250		
(7) Transportation costs— warehouse to customer.....		13,000		10,400		6,500		2,600		
Total.....	\$300,000	\$272,450	\$232,000	\$217,800	\$130,000	\$135,825	\$108,400	\$134,250	\$120,800	\$160,000
Net increase or decrease in profit.....	-0-	27,550	-0-	14,200	5,825	-0-	25,850	-0-	39,200	-0-
Total.....	\$300,000	\$300,000	\$232,000	\$232,000	\$135,825	\$135,825	\$134,250	\$134,250	\$160,000	\$160,000



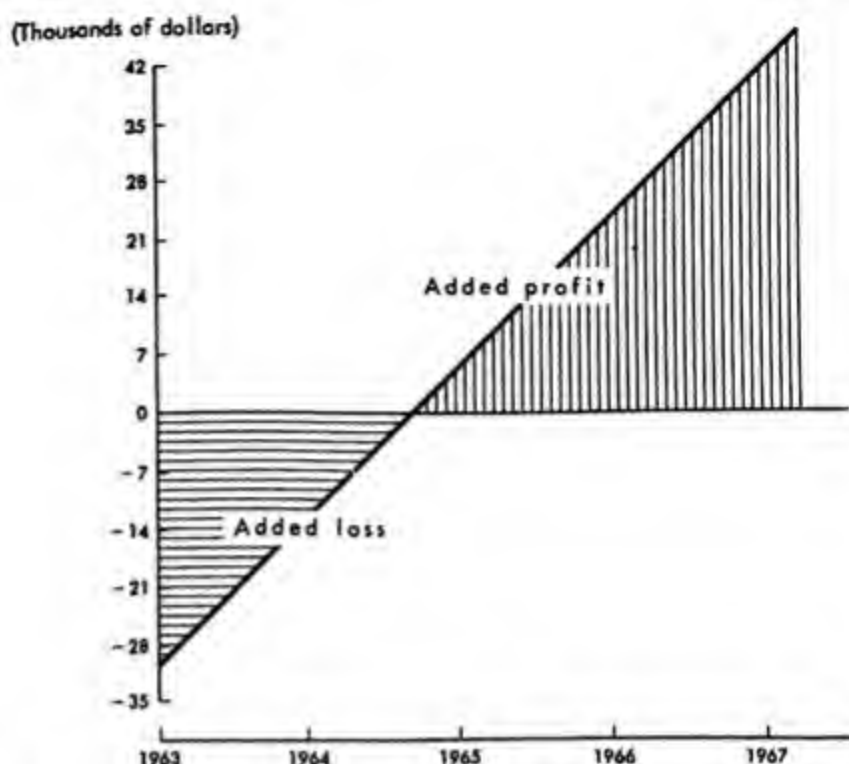


Fig. 19-1 National Appliance Company. Effect on profit of the elimination of Cleveland distributor (in millions of dollars).

averaged 50 cents per unit and from warehouse to customer 40 cents per unit.

The results of the study are shown graphically in Fig. 19-1 and in Exhibit 19-11. The replacement of distributors by company salesmen will increase profits during the 5-year period by an estimated \$29,125 and annually thereafter by \$39,200. Since the increased profits presumably will continue indefinitely, it is not necessary to calculate the present value of these profits. An explanation of the data contained in Exhibit 19-11, using the year 1963 as an example, follows:

(1) Loss in revenue:

	Units sold	Price, eliminating 20% discount	Amount
Revenue lost from distributors' sales.			\$640,000
Revenue gained by company salesmen:			
Product A .....	20,000	\$10	\$200,000
Product B .....	10,000	15	150,000
Product C .....	2,500	20	50,000
Total revenue gained .....			\$400,000
Net loss in revenue .....			\$240,000

- (2) Marginal selling costs ( $.15 \times 400,000$ ) ..... \$60,000  
 (3) Eliminator factory costs:

<i>Product</i>	<i>Reduction in units sold</i>	<i>Unit cost</i>	<i>Cost of lost revenue</i>
A	20,000	\$ 7	\$140,000
B	10,000	10	100,000
C	2,500	12	30,000
Total.....	32,500		\$270,000
Less 20% fixed.....			54,000
Eliminator factory costs.....			\$216,000

- (4) Eliminator warehouse costs ( $\$.80 \times 32,500$ ) ..... \$26,000  
 (5) Reduction of bad debts on lost revenue ( $.005 \times \$240,000$ ) ..... \$1,200  
 (6) Transportation costs from factory to warehouse ( $\$.50 \times 32,500$ )... \$16,250  
 (7) Transportation costs from warehouse to customer ( $\$.40 \times 32,500$ ) \$13,000

### *Determining the optimum number of salesmen*

How large a sales force should a company maintain? This is an important problem for most business concerns and one that all too often is resolved on the basis of inadequate criteria. The problem is concerned with the potential marginal income of successive salesmen. The point of sales saturation is reached when the potential, i.e., achievable, revenue of an additional salesman is less than the marginal costs applicable to him.

#### **Illustration of the determination of the optimum number of salesmen**

The Everwear Shoe Company manufactures a line of men's shoes which is sold throughout the country. Three salesmen are employed in the Middle Atlantic region. During the preceding 4 years their actual sales were as shown in Exhibit 19-12.

**Exhibit 19-12**

**EVERWEAR SHOE COMPANY**  
**Actual Sales—Middle Atlantic Region**  
**For the Years 1959 to 1962**  
 (In thousands of dollars)

<i>Salesman</i>	<i>1959</i>	<i>1960</i>	<i>1961</i>	<i>1962</i>
1	\$105	\$109	\$108	\$110
2	96	99	100	102
3	85	86	88	89
Total.....	\$286	\$294	\$296	\$301

Exhibit 19-13

EVERWEAR SHOE COMPANY  
Determination of the Optimum Number of Salesmen  
Middle Atlantic Region  
(In thousand of dollars)

Num- ber of sales- men	Estimated potential sales	Variable costs							Marginal sales	Marginal costs	Marginal profit or (loss)
		Variable factory	Sales- men's compen- sation	Gifts and entertain- ment	Travel	Cooper- ative advertising	Variable shipping, billing, etc.*	Total variable costs			
1	\$110	\$ 55.0	\$ 16.5	\$ 3.3	\$ 6.0	\$ 3.3	\$ 5.5	\$ 89.6	\$110	\$89.6	\$20.4
2	215	107.5	32.3	6.5	12.0	6.5	10.8	175.6	105	86.0	19.0
3	305	152.5	45.8	9.2	18.0	9.2	15.3	250.0	90	74.4	15.6
4	380	190.0	57.0	11.4	24.5	11.4	19.0	313.3	75	63.3	11.7
5	445	222.5	66.8	13.4	31.0	13.4	22.3	369.4	65	56.1	8.9
6	500	250.0	75.0	15.0	37.5	15.0	25.0	417.5	55	48.1	6.9
7	545	272.5	83.0	16.4	44.0	16.4	27.3	459.6	45	42.1	2.9
8	580	290.0	91.0	17.4	51.0	17.4	29.0	495.8	35	36.2	(1.2)
9	610	305.0	99.0	18.3	58.0	18.3	30.5	529.1	30	33.3	(3.3)
10	635	317.5	107.0	19.1	65.0	19.1	31.8	559.5	25	30.4	(5.4)

\* Although a constant variable rate has been assumed, in practice these expenses would tend to increase at an increasing rate.

Marginal sales and costs (in thousands of dollars)

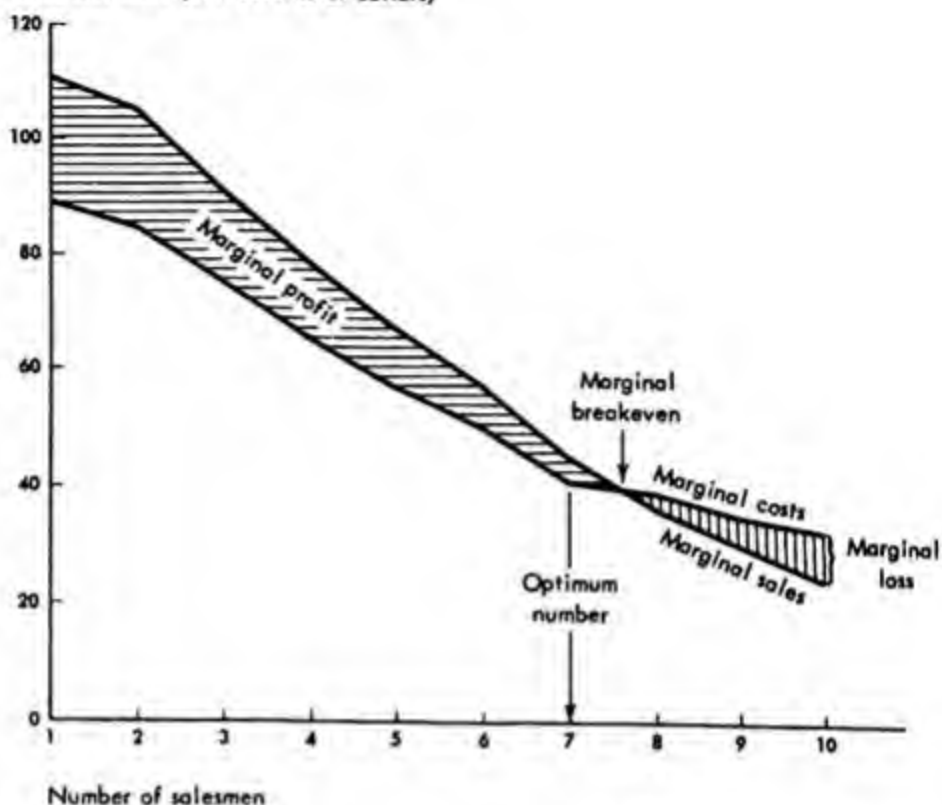


Fig. 19-2 Everwear Shoe Company. Determination of optimum number of salesmen—Middle Atlantic territory.

The sales vice-president requested the controller to determine the optimum number of salesmen that should be employed in the Middle Atlantic region. The results appear in Exhibit 19-13 and Fig. 19-2. Estimates of potential sales increments were based on market conditions, customer dispersion, and the use of appropriate economic indicators.

The decline in marginal sales occurred because successive salesmen contact less desirable and more widely dispersed customers. Also, traveling expenses of successive salesmen tended to rise for this reason. Salesmen's commissions amounted to 15 percent of sales with a guaranteed annual minimum salary of \$8,000. It is apparent from Exhibit 19-13 and Fig. 19-2 that there would be an advantage in the company's employing seven salesmen in this area. An eighth would produce a marginal loss of \$1,200.

### Break-even analysis for individual salesmen

A somewhat different approach to this type of problem is provided through break-even analysis for individual salesmen. The direct expenses and costs applicable to a salesman can be segregated into fixed, variable, and semivariable categories, as shown in Exhibit 19-14 for R. A. Thompson.

**Exhibit 19-14**

**Budgeted Selling Expenses**  
**Salesman: R. A. Thompson**

	<i>Fixed</i>	<i>Variable, % of sales</i>
Base salary.....	\$5,000	—0—
Commission.....	—0—	5.0 %
Traveling.....	4,000	.5
Entertainment and gifts.....	—0—	1.0
Cooperative advertising.....	—0—	3.0
Bad debts.....	—0—	.5
Freight.....	—0—	6.0
Variable factory.....	—0—	49.5
Total.....	<u>\$9,000</u>	<u>65.5</u>

The break-even point for the data contained in Exhibit 19-14 may be calculated as  $\$9,000 / (1 - .655)$ , or \$26,100. As long as Thompson's sales exceed \$26,100, a profit accrues to the company.

## *Problems and cases*

- 19-1** *Standard costs and budgeted expense allowances.* Discuss the difference in philosophy between standard cost measurement and control and the use of budgetary allowances in controlling administrative costs.

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- 19-2** *Cost control in factory and marketing.* Compare the variables involved in planning and controlling production costs with those in distribution cost analyses.

- 19-3** *Bases for allocating distribution costs.* What allocation factors might be appropriate in allocating the following distribution costs among products for product-pricing and price-justification purposes?

1. Salesmen's salaries
2. Salesmen's commissions
3. Transportation costs
4. Bad-debt losses
5. Direct product advertising
6. Institutional advertising
7. Finished-goods storage costs

- 19-4** *Controlling distribution costs.* Heebink Cereals, Incorporated, a manufacturer and distributor of nationally advertised cereals, utilized standard costs in controlling production costs. The controller currently was studying methods through which control over selling and distribution costs might be improved.



At the present time these costs were controlled through budgets which contained fixed dollar amounts for selling and distribution costs.

These budgets had been developed by using the bottom-up technique, rather than the top-down technique, in which selling department managers prepared budget requests 2 or 3 months before the budget year began. These requests were submitted to higher management levels, where in consultation with the selling department managers they were adjusted, negotiated, and approved. Past years' actual costs were an important guide in the development and approval of the budget appropriations. For control purposes, the actual costs were compared with the budgeted costs monthly. Budgetary allowances were not adjusted for changes in business activity throughout the year.

One of the methods being considered by the controller called for the separation of fixed and variable selling costs. The fixed budgetary allowances were set at the amount of total selling costs which would be incurred at a production level of 60 percent of capacity. This percentage was chosen because it was felt that the firm would not fall below this level unless there was a very serious economic slowdown.

The variable selling costs, in his proposal, were to be set as a standard percentage of sales. These percentages were determined by a study of actual total selling costs in a recent year which was considered typical, divided by sales revenues in this year. A different percentage was established for each major type of cost in the selling and distribution category. Thus the total cost allowance for salesmen's salaries would be calculated as the total of the fixed budgetary allowance plus a variable allowance amounting to the variable cost for this cost item multiplied by the actual sales revenue for the period.

1. What do you think of the proposal being considered by the controller?
2. What objections do you see to the old method of controlling selling and distribution costs?
3. What control method would you recommend?

- 19-5 *Control techniques for sales managers.* Once a sales manager's budget has been improved, what control techniques are available to him to aid in staying within the budget allowance?
- 19-6 *Control and the nature of distribution costs.* It is often suggested that there is no scientific basis for determining how much a distribution cost allowance should be because of the dependence of actual distribution costs upon current economic conditions and management policies and objectives. Discuss how business objectives and economic conditions and their effect upon distribution costs may be different from their effect upon production costs.
- 19-7 *Product-line evaluation.* A large drug company follows the practice of making an economic study of each of its product lines every 3 years. As a member of a committee assigned to accomplish this objective, what type of quantitative data do you think would be appropriate?
- 19-8 *Product profitability report.* What are the advantages and disadvantages to a company that prepares quarterly product profitability statements? What type of data should the report contain? Should variances from standard costs be shown?

- 19-9 *Order size profitability.* Outline a procedure for determining a company's profitability according to order size. Indicate what technical difficulties might be encountered and how you would deal with them.
- 19-10 *Eliminating loss from small orders.* You have completed a study of order size profitability which shows that the company is losing money, out of pocket, on small orders. What are the possible recommendations that you might make to management to improve the situation?
- 19-11 *Control of truck costs.* You are the controller of a wholesale food concern that employs a large fleet of trucks to deliver its products to retail outlets. What type of system and reports would you institute in regard to the trucking operation? In what ways do you think management would be assisted by this information?
- 19-12 *Data relevant to selecting channel of distribution.* A manufacturer of men's clothing is considering opening his own chain of retail outlets in addition to continuing to sell to independent clothing stores by direct salesmen. As cost accountant, how could you help your company's management reach a correct decision?
- 19-13 *Data relevant to decision on container.* You are a certified public accountant, and one of your clients is a local milk company. The company is considering bottling milk in gallon jugs, which the consumer would purchase and receive credit for on returning them empty. The company sells quart containers of milk for 25 cents and feels that if it could sell the gallon jug for 68 cents there would be a large market. If the jug is introduced, it is intended to sell it to large-volume stores only in neighboring towns that are at present not served by the company. You are asked to provide data for management to help it reach a proper decision. What kind of data would be relevant?
- 19-14 *Evaluating profitability of sales territory.* A large company prepares monthly profit and loss statements for each of its sales territories. These statements are used as a basis for paying bonuses to the territory managers. The aggregate of the territory statements equals the company's over-all monthly profit and loss. You are the manager of the southeastern region. What items in the statement are you likely to be critical of? Are these criticisms justified, and if so what can be done about them?
- 19-15 *Data for evaluating salesmen.* You are asked by the sales manager of your company to provide him with data for evaluating salesmen. What possibilities exist? Indicate the advantages and limitations of each criterion.
- 19-16 *Determining optimum number of salesmen.* You are the sales manager of a company that sells kitchen utensils from door to door. A large force of salesmen is employed on a combined salary and commission basis. How can you determine the number of salesmen to employ? What difficulties will you encounter?
- 19-17 *Product-line profitability.* Prepare an exhibit showing sales, costs, and operating net income for each line of goods distributed by the Argo Grocery Company. Furnish supporting exhibits, indicating clearly how the items of expense have been apportioned. Show results only to the nearest dollar.

The Argo Grocery Company manufactures and distributes in a limited area two lines of grocery products. One line is distributed to hotels and restaurants, the other to retail grocers. Selling organizations for the two lines are separately set up and operated, and there is considerable rivalry between them. There is also a good deal of argument about which line nets the greater income to the company. Total dollar volumes of the two lines are roughly equal, but because of competitive conditions, the margins in the restaurant line are relatively narrow, while wider margins are enjoyed by the retail line. From this fact the sales manager for the retail line argues that his line contributes more to the company's net income. The restaurant sales manager, however, insists that the distribution costs per dollar of sales for his line are sufficiently lower to make up for the difference in margin.

In an attempt to settle the argument the following facts about the company's 1962 business have been ascertained:

Both lines are stored in a single warehouse, and packing and shipping activities are carried on by the same crew. The restaurant line consists of 10 items and is sold in shipping containers supplied by the factory and included as part of factory cost. The retail line consists of 50 items. The goods must be assembled and packed in containers after orders are received. Time studies indicate that it takes about four times as long to prepare \$100 worth (at selling price) of retail goods for shipment as in the case of restaurant goods. Restaurant goods are delivered at the warehouse dock to customers' trucks or to common carriers; in the latter case the customers pay the freight. The company's own delivery equipment is used entirely for the retail line.

Advertising is directed entirely at the ultimate consumer, with the aim of persuading him to demand the company's products at stores and in public eating places. It consists of newspaper advertising and of display matter and leaflets supplied to dealers. About 10 percent as much newspaper space is

### *Exhibit I*

#### Expense Data

##### Sales force salaries and expense:

Restaurant line.....	\$15,000
Retail line.....	35,000
Warehouse depreciation, insurance, etc.....	4,000
Packing and shipping wages.....	10,000
Shipping containers.....	800
Other shipping supplies (proportionate to number of sales invoices)....	600
Delivery wages, supplies, and expense.....	3,000
Newspaper advertising.....	11,000
Display material and dealers' helps.....	2,500
Advertising salary.....	1,650
Office and clerical salaries (see Exhibit II).....	5,000
Office supplies and equipment expense.....	1,600
Executive salaries and expense (apportion on basis of sales).....	8,000
Bad-debts allowance.....	1,590
<b>Total.....</b>	<b><u>\$99,740</u></b>

**Exhibit II**  
**Operating Data**

	<i>Restaurant</i>	<i>Retail</i>
Sales.....	\$240,000	\$270,000
Factory cost of sales.....	\$200,000	\$180,000
Warehouse space occupied by \$100 worth, at cost, cu ft.....	30	60
Average inventory, at cost.....	\$20,000	\$40,000
Number of sales invoices.....	1,000	9,000
Average number of items per invoice.....	4	12
Number of customers.....	28	224
Average customers' accounts outstanding.....	\$20,000	\$40,000

**Analysis of office and clerical time:**

	<i>Percent</i>
Keeping warehouse stock records.....	5
Preparing order and sales invoice forms.....	25
Posting sales invoices.....	15
Receiving cash and posting cash receipts.....	5
Preparing customers' statements.....	5
Credit and collection activities.....	10
General accounting and clerical (apportion on the basis of sales)	35
	<u>100</u>

(AICPA)

devoted to the restaurant line as to the retail line. The company's advertising staff consists of one man, who spends two-thirds of his time on newspaper advertising and the balance on display and leaflet material.

Exhibit I lists the operating expenses of the company other than those concerned with manufacturing. Exhibit II lists important operating data ascertained in the course of your investigation. The apportionment of office and clerical time is the result of time studies and estimates. It is the opinion of the management that office supplies and equipment expense roughly parallel the office and clerical salaries. The management rejects as inadmissible the inclusion of interest on investment. Approximately one-half the time of credit and collection employees is spent in routine checking orders for credit approval. The balance is spent on credit followups and attempts to collect specific accounts. Experience indicates that the average retail account is about five times as likely to require such collection effort as the average restaurant account. Historical records show that about  $\frac{1}{2}$  of 1 percent of retail sales are never collected, while only  $\frac{1}{10}$  of 1 percent of restaurant sales prove to be uncollectible.

Ninety percent of the job of keeping warehouse stock records is concerned with shipments and 10 percent with receipts from the factory. All items of the restaurant line are received at the warehouse every day, but items in the detail line are received on the average only every other day.



- 19-18 *Establishing distribution cost standards and comparing actual and standard expenditures.* The Treadwell Shoe Company desires to establish standards for the control of the expenses of distributing its product, including advertising, selling, shipping, delivery, and sales administrative costs. Based on an analysis of 1961 expenditures, the following expenses are budgeted for 1962:

Advertising and selling:

Magazine and newspaper space.....	\$ 77,100
Art work, copy, etc.....	48,000
Advertising department salaries.....	60,900
Sales force salaries.....	199,800
Sales travel expense.....	126,900
Samples, equipment, etc.....	15,600
Sales office salaries.....	48,900
Printing.....	14,700
Stationery.....	11,400
Postage.....	6,300
Telephone and telegraph.....	6,900
Other selling expenses.....	6,600
Total.....	<u>\$ 623,100</u>

Shipping and delivery:

Shipping department labor.....	\$ 51,300
Packing supplies.....	31,800
Truck and garage.....	8,100
Freight, express, parcel post.....	189,600
Total.....	<u>\$ 280,800</u>

Administrative:

Officers' salaries.....	\$ 72,000
Clerical salaries.....	73,800
Stationery and printing.....	15,600
Postage.....	3,900
Telephone and telegraph.....	5,400
Maintenance—office equipment.....	3,600
Depreciation—office equipment.....	6,600
General expense.....	11,100
Total.....	<u>\$ 192,000</u>
Total distribution expense.....	<u><u>\$1,095,900</u></u>

The company's controller points out that the establishment of standards will require an analysis of expenses in terms of functions performed. Being asked to divide into functions the activities of the various departments concerned with the distribution of the product, he prepares the following list:



## Advertising:

Magazine and newspaper space  
Direct mail  
Dealers' helps  
Supervision

## Selling:

Sales force compensation  
Sales force travel  
Samples, equipment, etc.  
Supervision

## Administration:

Sales management  
Analyses and reports

## Handling and delivery:

Filling orders  
Packing and loading  
Delivery to station  
Preparing invoices and shipping documents  
Pricing, extending, footing, and billing invoices  
Freight, express, parcel post  
Traffic, claims

## Credit and collection:

Posting invoices  
Posting cash  
Statements, trial balances, etc.  
Credit investigation, collection expense, etc.

An analysis of the planned expenses for 1962 discloses the following facts:

1. Art work, copy writing, etc., is 50 percent for magazine and newspaper advertising, 30 percent for direct-mail material, and 20 percent for dealer's helps.
2. Advertising department salaries include advertising manager \$21,000; artists and copy writers \$28,800; clerks on direct-mail advertising \$6,900; clerks on dealers' helps \$4,200.
3. Of the printing, stationery, postage, and telephone cost charged to advertising and selling, direct mail amounts to \$20,700, dealers' helps \$9,300, and general sales supervision \$9,300.
4. Shipping department labor includes \$17,400 for selecting stock and checking orders, \$24,600 for packing and loading, and \$9,300 for wages of truck drivers.
5. Administrative clerical salaries include accounting department salaries classified as follows: preparing invoices and shipping documents \$8,400; pricing, extending, footing, and billing invoices \$9,600; keeping sales journal and posting invoices \$7,800; recording and posting cash collections \$5,700; preparing customers' statements, customers' ledger trial balances, etc., \$8,400; making sales analyses and reports \$9,300. Other salaries included in the total are for traffic department \$11,400 and credit department \$13,200.
6. Stationery and printing include salesmen's order blanks, invoices, etc., \$9,900; customers' ledger sheets, statements, blanks, etc., \$5,700.
7. Postage on orders, invoices, etc., amounts to \$2,100; on statements \$1,200; on traffic matters \$300; on credit and collection matters \$300.

8. Telephone and telegraph expense is divided between credits and collections \$4,200; traffic matters \$1,200.
9. Maintenance and depreciation of office equipment may be considered as applying \$5,400 to billing, \$4,500 to credits and collections, and \$300 to traffic.
10. General expense applies \$2,400 to billing, \$6,300 to credit and collection expense, and \$2,400 to traffic.

A study of the situation convinces the management that, for the purpose of setting standards and comparing actual and estimated performances, the different functional costs may be expected to vary in relation to the number of units of functional service required in distribution of the product. The units of measurement for each expense function and the planned level of activity in 1962 are indicated below.

Number of customer calls or solicitations (5,000 in 1962):

- Direct mail advertising
- Sales force compensation
- Sales force samples, equipment, etc.

Number of days of sales travel (4,200 in 1962):

- Sales force travel expense

Number of customers sold (2,000 in 1962):

- Cost of dealers' helps
- Expense of preparing customers' statements
- Credit and collection expenses in general

Number of orders taken (15,000 in 1962):

- Cost of preparing invoices and posting invoices
- Expense of traffic, claims, etc.

Number of order lines (75,000 in 1962):

- Cost of filling orders
- Pricing, extending, footing, and billing invoices
- Preparing sales analyses and reports

Number of units of product sold (600,000 in 1962):

- Cost of packing and loading
- Cost of delivery to station or post office

Weighted shipment mileage (300,000 weight miles in 1962):

- Freight, express, parcel post

Number of cash collections (10,000 in 1962):

- Recording and posting cash

Fixed standard:

- Magazine and newspaper space
- Advertising supervision
- Sales force supervision
- General sales management

Actual results during the year 1962 are shown in the following table, items being arranged in accordance with the unit of measurement (or factor of variation) applied to each functional cost.

Number of customer solicitations (5,520):	
Direct mail advertising.....	\$ 45,900
Sales force compensation.....	208,200
Sales force samples, equipment, etc.....	17,400
Number of days' travel (4,520):	
Sales force travel.....	123,900
Number of accounts sold (2,210):	
Dealers' helps.....	27,300
Statements, etc.....	17,100
Credit and collections.....	20,100
Number of orders taken (18,420):	
Preparing invoices.....	15,600
Posting invoices.....	7,200
Traffic, claims.....	10,800
Number of order lines (80,700):	
Filling orders.....	21,300
Pricing, extending, footing, and billing.....	17,400
Sales analyses.....	7,800
Number of units of product sold (583,400):	
Packing and loading.....	53,100
Delivery to station.....	17,400
Weighted shipment mileage (302,700):	
Freight, express, parcel post.....	203,400
Number of cash collections (11,100):	
Posting cash.....	5,100
Fixed standard:	
Magazine and newspaper advertising.....	123,900
Advertising supervision.....	30,300
Sales supervision.....	58,400
General management.....	72,000
Total actual expenses 1962.....	<u>\$1,103,600</u>

*Required:*

1. Establish the standard for 1962 for each functional activity.
2. Compare the actual expenses in 1962 with the standard adjusted to the actual level of activity, and show the variance for each function.
3. Evaluate the system.

**19-19 Incremental profit or loss.** A company operating a factory manufacturing neckwear and shirts has been offered a contract for the making of 2,000 dozen shirts at a price of \$3.75 per dozen. All materials are to be supplied free by the concern offering the contract.

You are informed that this contract could be handled with the present equipment and without any effect on the producing or marketing of regular lines. You are also informed that the additional expenditures that would be incurred by accepting this contract are estimated as follows:

1. Piecework wages at the same average rate as paid in previous year.
2. An additional cutter would be required for a period of 10 weeks at \$30 per week. Cutters are not on a piecework basis.

3. Additional factory expenses \$500.
4. Allowance for contingencies, etc., \$500.

The following information is obtained from the company's last annual statement and from other records (the experience of this single year is quite average in relation to earlier periods and to the industry generally):

	<i>Neckwear department</i>	<i>Shirts department</i>
Sales .....	\$155,000	\$270,000
Materials used .....	\$ 94,500	\$172,500
Wages, piecework .....	18,000	27,000
Wages, day work, productive .....	5,000	10,000
Depreciation of equipment, etc. ....	750	900
Total distributed expenses .....	<u>\$118,250</u>	<u>\$210,400</u>

Undistributed expenses:

Wages, unproductive .....	\$10,500
Wages, shipping .....	\$1,800
Factory expenses .....	\$7,250
Factory stationery .....	\$750
Advertising .....	\$5,750
Rent .....	\$4,500
Interest and bank charges .....	\$3,250
Office expenses .....	\$6,300
Office and management salaries .....	\$15,200
Bad debts .....	\$2,500
Salesmen's commissions .....	\$17,280
Floor space, neckwear department, sq ft. ....	2,800
Floor space, shirts department, sq ft. ....	5,700
Floor space, office and shipping department, sq ft. ....	500

Salesmen are paid the same commission per dozen, neckwear or shirts. It is estimated that the production for the coming year, excluding this proposed contract, will be the same as the year just ended, i.e., neckwear 18,000 dozen, shirts 15,000 dozen.

State whether or not you would recommend accepting this contract, giving reasons and figures.

(Canadian Chartered Accountants examination)

- 19-20 *Product-line profitability.* The Durable Kitchen Equipment Company manufactures and sells two distinct lines of kitchenware, one to restaurants and one to retail stores. Restaurant sales are made to distributors and store sales through company salesmen.

The company has been successful and is operating at full capacity. However, because of a recent lawsuit, its cash is very limited. Therefore, it will not be able to construct a plant addition, to meet the increasing demand for its products, for at least another year. However, the company has rented, for a 2-year period, additional space adjacent to its present factory. The rental expense is included among the allocated costs in Exhibit I. This space is

## Exhibit I

## THE DURABLE KITCHEN EQUIPMENT COMPANY

## Income Statement

For the Year Ended December 31, 1962

	<i>Restaurant line</i>	<i>Retail line</i>	<i>Total</i>
Sales.....	\$1,800,000	\$1,700,000	\$3,500,000
Cost of sales:			
Materials.....	\$ 400,000	\$ 320,000	\$ 720,000
Labor.....	300,000	240,000	540,000
Variable overhead.....	200,000	250,000	450,000
Fixed overhead.....	270,000	210,000	480,000
Total.....	\$1,170,000	\$1,020,000	\$2,190,000
Gross profit.....	\$ 630,000	\$ 680,000	\$1,310,000
(% to sales).....	(35.0)	(40.0)	(37.4)
Less: Selling and administrative expenses			
Direct:			
Salesmen's commissions.....	-0-	\$ 136,000	\$ 136,000
Salesmen's traveling and entertain- ment.....	-0-	85,000	85,000
Truck depreciation, insurance, and licenses.....	\$ 14,400	-0-	14,400
Truck drivers' salaries.....	65,000	-0-	65,000
Truck garage rental.....	3,600	-0-	3,600
Gasoline and other truck supplies.....	28,000	-0-	28,000
Commissions to distributors.....	180,000	-0-	180,000
Freight.....	6,000	62,000	68,000
Bad debts.....	4,500	6,000	10,500
Total direct.....	\$ 301,500	\$ 289,000	\$ 590,500
Allocated:			
Warehouse (basis of space).....	\$ 40,000	\$ 80,000	\$ 120,000
Selling (sales).....	48,000	32,000	80,000
Advertising (sales).....	36,000	24,000	60,000
Administrative (sales).....	54,000	36,000	90,000
Total allocated.....	\$ 178,000	\$ 172,000	\$ 350,000
Total selling and administrative.....	\$ 479,500	\$ 461,000	\$ 940,500
Profit before income taxes.....	\$ 150,500	\$ 219,000	\$ 369,500
(% to sales).....	(8.4)	(12.9)	(10.5)
Capital employed			
Variable:			
Average monthly cash.....	\$ 72,000	\$ 48,000	\$ 120,000
Average monthly inventories.....	120,000	240,000	360,000
Average monthly receivables.....	162,000	184,000	346,000
Total.....	\$ 354,000	\$ 472,000	\$ 826,000
Fixed.....	1,144,000	1,372,000	2,516,000
Total capital.....	\$1,498,000	\$1,844,000	\$3,342,000
Return on capital.....	10.0%	11.9%	11.0%



adequate to permit a 20 percent sales expansion in either the restaurant line or the retail line. Either line could absorb the added factory output without requiring any additional sales effort.

The average price per unit in the restaurant line is \$20 and in the retail line \$5. The restaurant products are boxed at the plant, and the boxing costs are included in cost of sales. The retail items are boxed at the warehouse.

As a consultant, you are requested to review the data contained in the company's annual income statement (Exhibit I). The president states: "It is clear that we should allot this additional space to the retail line since it brings in 12.9 cents on a dollar as compared with 8.4 cents for the restaurant line. It also shows a greater return on capital. Before going ahead with this plan, however, I would like you to look over our income statement to see that the data are correct."

In the course of your examination of the company's income statement you discover the following additional information:

1. If the rented space is to be devoted to restaurant products, no additional trucks will be required. However, present truck running time would have to be increased by 10 percent. The additional 10 percent running time will require proportionate overtime payments to truck drivers, at time and a half.
2. Among the allocated selling and administrative expenses, you find the following:
  - a. Variable billing costs are estimated at 40 cents an invoice. The average value of an invoice to restaurant customers is \$500 and to retail customers \$100.
  - b. Advertising includes counter displays for the retail line, which amounts to 1 percent of sales.
  - c. Salaries of the advertising and credit managers amount to \$35,000. It is estimated that they spend approximately two-thirds their time on retail accounts.
  - d. Variable shipping salaries at the warehouse are equal to 80 cents per unit for restaurant products and 50 cents per unit for retail products. Warehouse boxing costs (including cartons) amount to 40 cents per unit.

*Required:* Prepare an analysis of the data for the president. Assume that the value of money to the company is equal to 10 percent.

- 19-21** *Order size profitability.* The Metro Meat Packing Corporation serves a large metropolitan population. It cuts, packs, and delivers meats according to customers' orders. Its income statement for the year ended December 31, 1962, appears in Exhibit I.

Customers are contacted by company salesmen. All customers are visited at least once a month and larger accounts weekly. Small accounts also are solicited by telephone by an order clerk. Deliveries to customers are made in company refrigerated trucks. A uniform price per pound exists, and customers are sold on open credit.

An analysis of sales according to size of customers' orders is presented in Exhibit II and additional statistical data relevant to order size in Exhibit III.

*Required:*

1. Should any order size be eliminated?
2. What other possibilities exist?

*Exhibit I*

**THE METRO MEAT PACKING CORPORATION**  
**Income Statement**  
**For the Year Ended December 31, 1962**

Sales.....	\$980,000
Less: Variable costs	
Meats.....	\$416,500
Cutting and packing.....	98,000
Variable cutting and packing overhead.....	98,000
Loading and unloading.....	15,800
Selling salaries.....	94,800
Salesmen's travel.....	21,600
Order clerk—salary and telephone.....	5,600
Bad debts.....	5,900
Cooperative advertising.....	6,800
Trucks—gas, oil, and supplies.....	11,300
Trucks—repairs.....	7,200
Total variable costs.....	\$781,500
Contribution to fixed overhead and profit.....	\$198,500
Less: Fixed costs	
Administrative salaries.....	\$ 82,000
Office salaries.....	19,400
Rent, taxes, and insurance.....	9,700
Utilities.....	5,300
Depreciation—trucks.....	20,900
Taxes, licenses, garage rental, etc.—trucks.....	4,200
Total fixed costs.....	\$141,500
Profit before income taxes.....	\$ 57,000

*Exhibit II*

**THE METRO MEAT PACKING CORPORATION**  
**Analysis of Sales by Order Size**  
**For the Year Ended December 31, 1962**

<i>Order size</i>	<i>Sales</i>	
	<i>Pounds*</i>	<i>Amount</i>
Less than \$25.....	100,000	\$ 81,700
\$ 25- 50.....	114,000	93,100
\$ 50-100.....	136,000	110,200
\$100-200.....	140,000	114,500
\$200-500.....	200,000	163,500
\$500-1,000.....	270,000	220,800
Over \$1,000.....	240,000	196,200
Totals.....	1,200,000	\$980,000

\* Rounded.

**Exhibit III**

**THE METRO MEAT PACKING CORPORATION**  
 Analysis of Sales by Order Size  
 For the Year Ended December 31, 1962

<i>Order size</i>	<i>Average time to cut and pack an order, min</i>	<i>Average time to load and unload an order, min</i>	<i>Average number of telephone calls per customer per month</i>	<i>Average number of salesmen's visits per customer per month</i>	<i>Number of customers</i>	<i>Bad debts as a % of total</i>	<i>Actual cooperative advertising</i>	<i>Average number of orders filled a day</i>
Less than \$25	5	4.5	5	1	300	31%	\$ 400	150
\$ 25- 50	9	4.5	5	1	250	25	700	90
\$ 50-100	16	8.6	4	2	150	22	1,100	45
\$100-200	30	13.4	2	3	50	17	1,200	25
\$200-500	55	15.7	1	4	40	5	1,100	22
\$500-1,000	100	18.9	-0-	4	20	-0-	1,200	10
Over \$1,000	170	30.5	-0-	5	10	-0-	1,100	5

19-22 *Choosing between alternative marketing proposals.* A corporation, engaged in manufacturing and wholesaling two principal products, has called upon you for advice on its sales policy for the coming year.

Last year variable selling expenses were 12 percent of the sales, of which one-third was for advertising. Variable administrative expenses were 2 percent of the sales.

Two propositions are now under consideration by the management by either of which they hope to increase the profits of the company. These propositions are outlined to you by the management as follows:

Proposition 1. Premium stamp books. Premium stamp books will be widely distributed to consumers, who will obtain stamps from the packaged products. When a book is filled with stamps (100 stamps to each book), it may be returned to the corporation and will be redeemed by the award of a prize or premium described under the unbroken seal attached to the book and intact at the time of presentation. A table of such prizes and premiums which the management proposes in this plan is as follows:

<i>Number of books</i>	<i>Prize each</i>	<i>Amount</i>
1	\$150.00	\$ 150
5	50.00	250
14	20.00	280
50	10.00	500
160	5.00	800
1,020	1.00	1,020
8,750	0.40	3,500
<u>10,000</u>		<u>\$6,500</u>

Every 10,000 books distributed will provide for prizes in accordance with the above table. *This is definitely fixed and not subject to alteration or modification.*

The cost of this plan will be as follows:

Books, including expense of distribution.....	\$ 15 per thousand books
Stamps.....	1 per thousand stamps
Prizes, according to schedule.....	650 per thousand books

It is proposed that each package of product A shall contain 8 premium stamps and each package of product B 4 premium stamps. The premium stamp book plan is intended to take the place of all previous advertising, which will be immediately discontinued if this proposition is adopted. Selling prices previously established will be maintained without change.

Proposition 2. Reduced selling prices. Under this plan it is proposed to reduce selling prices of product A by 8½ percent and of product B by 5 percent and to continue all previous advertising with some increase therein. This proposition is being considered as an alternative to proposition 1, and if adopted no use will be made of premium stamp books.

	Product A	Product B
Facts as to last year's operations:		
Units sold.....	200,000	600,000
Variable production costs per unit.....	30¢	24¢
Fixed production costs per unit.....	10¢	6¢
Selling prices per unit.....	60¢	40¢
Expected changes:		
Increase in unit sales volume		
Proposition 1.....	50 %	50 %
Proposition 2.....	40 %	25 %
Advertising		
Proposition 1.....	None	None
Proposition 2.....	7 % of sales	6 % of sales
Other variable selling expenses		
Proposition 1.....	10 % of sales	8 % of sales
Proposition 2.....	6 % of sales	6 % of sales
Variable administrative expenses		
Proposition 1.....	3 % of sales	3 % of sales
Proposition 2.....	Same amount as last year	

In proposition 1, it is assumed that premium stamp books and stamps will be distributed in exactly sufficient quantities to supply every customer under the proposed schedule of sales and that all such books and stamps will be redeemed.

Prepare an exhibit, such as you would submit to management, giving a comparison of the prior year's operations and the results that would be obtained under the two propositions.

(AICPA adapted)

- 19-23 *Evaluating the desirability of a marketing proposal.* The Darlu Meat Distributing Company purchases, stocks, and distributes meats to butcher shops in a large American city. It maintains a fleet of 10 trucks, which are operated at about full capacity. The company's income statement for the year ended December 31, 1962, appears in Exhibit I.

The management of the Darlu Company has been concerned about the unprofitable 1962 operations, since the company has earned at least modest profits for many years. The company's auditor has pointed out that the 1962 loss primarily can be attributed to the acquisition of a large cold-storage plant in January, 1962. Prior to 1962, the company rented cold-storage space. The cold-storage plant acquired in 1962 is approximately 40 percent larger than the company at present needs. A small portion of this excess capacity has been rented on a month-to-month basis to a local dairy company at \$5,000 rent per annum.

At the close of 1962, the company's management was considering a proposal made by a large department store for home deliveries of meats and frozen canned products. According to the proposal, the department store would sell freezers with a guarantee that the purchaser would receive meats and canned foods ordered at 10 percent below the prevailing retail price for the same items. Advertising, which would be budgeted at \$40,000 a year, would be shared equally. The department store would handle the receivables and col-



*Exhibit I*

## THE DARLU MEAT DISTRIBUTING COMPANY

## Income Statement

For the Year Ended December 31, 1962

Sales.....	\$840,000
Less: Variable costs	\$640,000
Meats.....	10,000
Cold storage—loading and unloading.....	3,000
Truck repairs.....	12,000
Truck oil, gas, and supplies.....	2,000
Truck, miscellaneous.....	\$667,000
Total variable costs.....	\$173,000
Contribution to fixed costs and profit.....	
Less: Fixed costs	\$ 2,000
Truck maintenance.....	20,000
Truck depreciation.....	5,000
Truck insurance, taxes, licenses, etc.....	65,000
Truck drivers' salaries.....	5,000
Cold-storage depreciation plant and facilities.....	28,000
Cold-storage supervision and maintenance.....	4,000
Cold-storage taxes and insurance.....	8,000
Cold-storage utilities.....	1,000
Administrative, depreciation office and equipment.....	16,000
Administrative, office salaries.....	1,000
Administrative, utilities.....	6,000
Administrative, miscellaneous.....	32,000
Administrative, executive salaries.....	1,000
Administrative, financial charges.....	\$194,000
Total fixed costs.....	\$(21,000)
Loss before other income.....	5,000
Rental of cold-storage space.....	\$ 16,000
Net loss.....	

lections and assume all credit risks but would charge Darlu 1 percent of the gross food sales for this service.

A market survey undertaken by the department store has been made available to the management of the Darlu Company. The survey indicates that a large potential market exists and that home deliveries would consist of approximately 80 percent meats and 20 percent canned foods.

Inquiries have indicated that the company could obtain a leading line of canned foods delivered at its cold-storage plant at 15 percent below the retail price.

If the company accepted the offer, it would be necessary to cut and pack the meats. Adequate space for this operation could be procured adjacent to the cold-storage plant at an annual rental of \$4,000.

In estimating the desirability of home deliveries, it was decided to use a forequarter of beef for the calculation of expected profitability. Beef would

*Exhibit II*

**THE DARLU MEAT DISTRIBUTING COMPANY**  
Cuts and Prices Obtained from a Beef Forequarter

<i>Cut</i>	<i>Pounds</i>	<i>Retail price per pound</i>	<i>Retail value</i>
Rib steak .....	24	\$ .67	\$ 16.08
Oven roasts .....	14	.67	9.38
Chuck roasts .....	36	.59	21.24
Boneless beef cubes .....	4	.59	2.36
Braising beef .....	24	.59	14.16
Beef patties .....	2	.49	.98
Pot roast .....	14	.59	8.26
Prime rib roast .....	16	.79	12.64
Cube steaks .....	6	.59	3.54
Ground beef .....	30	.49	14.70
	170		\$103.34

represent the bulk of meat sales, and the cutting and packing and profit margin on beef was regarded as typical for other meats. The cuts of meat obtained from a forequarter of beef and the retail prices are indicated in Exhibit II.

The cost of cutting and packing 100 beef forequarters was estimated as shown in Exhibit III.

The company's profit projection was based on the assumption that all the cold-storage space, including that at present rented, would be used for the

*Exhibit III*

**THE DARLU MEAT DISTRIBUTING COMPANY**  
Estimated Cost of Cutting and Packing 100 Beef Forequarters

Cost of 100 beef forequarters .....	\$7,060
Cutting .....	\$ 150
Packing .....	80
Variable cutting and packing overhead .....	230
Total conversion cost .....	\$ 460
Gross cost of 100 cut and packed forequarters .....	\$7,520
Less: Sale of scraps .....	80
Net cost of 100 cut and packed forequarters .....	<u>\$7,440</u>

home-delivery operation. It was estimated that eight additional trucks of the same type as those at present in operation would be needed and truck costs and loading costs would follow the same pattern per truck as at present. Trucks would cost \$8,000, after allowing for trade-in and would have 4-year lives. The company believes that the cost of capital (inventories are to be ignored) is equal to 15 percent. Each truck would operate 40 hours a week for 50 weeks a year and could make 15 deliveries a week. The average home delivery would amount to approximately \$200. An additional executive would be required, at \$10,000 per annum.

*Required:* Should the Darlu Company accept the department store's offer, on the assumption that it would be able to utilize all its present cold-storage space and eight additional trucks would be required?

- 19-24 *Evaluation of profitability of a sales territory.* The Silver Fan Company is one of the oldest industrial electric-fan manufacturing companies operating in the Northeastern and North Central part of the United States. In recent years, it has added electric motors and generators to its line. Although substantial amounts are spent on advertising and promotion, because of the technical nature of the products, sales essentially are obtained by salesmen. Its products are sold in four sales territories that have about the same market characteristics. Product prices are uniform in all territories. Each territorial sales manager has wide latitude in regard to operations, and the nature of the selling, warehousing, and delivery functions varies from territory to territory. The company's factory is operating at about 70 percent of its potential capacity, on a single-shift basis.

In January, 1963, the controller received the following memorandum from the president:

"As you know, territory 4 has been unprofitable for many years and has made no significant progress in overcoming its losses. Of late, I have been thinking that perhaps we would be better off to eliminate the territory and thus increase our over-all profits. I would like you to investigate the situation carefully and report to me as soon as possible. If you do not think we should eliminate the territory, I shall expect you to indicate why not and to suggest how we can convert the loss into a satisfactory profit."

The company regards the cost of money as being equal to 15 percent pre-tax. Territory 4's inventory turns over five times a year, i.e., in relation to sales. Receivables turn over approximately every 30 days. The market value of the warehouse building is to be considered equal to the acquisition cost, and the market value of the warehouse facilities and delivery trucks is about equal to one-half the acquisition cost.

Following the controller's instructions, his staff prepared the data appearing in Exhibits I through IV.

*Required:* Based on the data shown, prepare a report to the president, assuming you are the controller.

## THE SILVER FAN MANUFACTURING COMPANY

## Income Statement

For the Year Ended December 31, 1962

	Territory 1		Territory 2		Territory 3		Territory 4		Total company	
	Amount	% of sales	Amount	% of sales	Amount	% of sales	Amount	% of sales	Amount	% of sales
Units sold.....	140,000		66,200		108,000		60,000			
% of potential market.....	10.5		10.1		11.0		8.7			
Sales.....	\$3,600,000	100	\$2,150,000	100	\$3,500,000	100	\$2,000,000	100	\$11,250,000	100
Cost of sales.....	1,916,000	53.2	1,290,000	60	2,200,000	62.9	1,389,000	69.4*	6,795,000	60.4
Gross profit.....	\$1,684,000	46.8	\$860,000	40	\$1,300,000	37.1	\$611,000	30.6	\$4,455,000	39.6
Less: Direct territory expenses										
Selling.....	\$ 332,000	9.2	\$ 188,000	8.7	\$ 320,000	9.1	\$ 180,000	9.0	\$ 1,020,000	9.1
Delivery.....	180,000	5.0	100,500	4.7	149,000	4.3	122,000	6.1	551,500	4.9
Warehousing†.....	152,000	4.2	105,000	4.9	183,000	5.2	150,000	7.5	590,000	5.2
Direct advertising and sales promotion.....	137,000	3.8	105,000	4.9	120,000	3.4	95,600	4.8	457,600	3.0
Office (fixed)†.....	90,000	2.5	72,000	3.3	83,000	2.4	70,000	3.5	315,000	2.1
Total.....	\$ 891,000	24.7	\$ 570,500	26.5	\$ 855,000	24.4	\$ 617,600	30.9	\$ 2,934,100	24.3
Profit margin before allocated selling and administrative expenses.....	\$ 793,000	22.1	\$ 289,500	13.5	\$ 445,000	12.7	\$ (6,600)	(.3)	\$1,520,900	15.3
Less: Allocated selling and administrative expenses (basis of sales).....	288,000	8.0	172,000	8.0	280,000	8.0	160,000	8.0	900,000	8.0
Profit or loss before income taxes	\$ 505,000	14.1	\$ 117,500	5.5	\$ 165,000	4.7	\$ (166,600)	(8.3)	\$ 620,900	7.3

\*Variable 52.9%, fixed 16.5%.

† Each territory maintains a separate office and warehouse.

*Exhibit II*

## THE SILVER FAN MANUFACTURING COMPANY

## Selling Statistics

For the Year Ended December 31, 1962

	<i>Territory 1</i>	<i>Territory 2</i>	<i>Territory 3</i>	<i>Territory 4</i>
Number of salesmen.....	36	20	32	15
Average sales per salesman.....	\$100,000	\$107,500	\$109,375	\$133,333
Average direct selling, advertising, and promotion expenses per salesman.....	\$13,000	\$14,600	\$13,800	\$18,300
Average number of calls per customer per month (according to customer annual sales volume)				
\$ 0-200	1.0	.6	1.0	.5
\$201-400	1.8	1.6	1.9	1.4
\$401-600	2.9	2.8	2.7	2.0
\$601-800	5.0	4.3	4.1	3.2
Over \$800	5.2	5.2	5.1	5.1

*Exhibit III*

## THE SILVER FAN MANUFACTURING COMPANY

## Delivery Expenses and Statistics

For the Year Ended December 31, 1962

	<i>Territory 1</i>	<i>Territory 2</i>	<i>Territory 3</i>	<i>Territory 4</i>
Truck driver.....	\$ 79,000	\$ 16,000	\$ 25,000	\$ 76,000
Driver's assistant.....	54,000	-0-	-0-	-0-
Depreciation of trucks (25%)..	19,000	3,200	5,700	18,600
Gas, oil, and supplies.....	20,000	4,000	6,200	19,800
Taxes, insurance, and licenses..	3,800	500	800	3,600
Repairs and maintenance.....	4,200	600	800	4,000
Freight out.....	-0-	76,200	110,500	-0-
Total.....	\$180,000	\$109,500	\$149,000	\$122,000
Number of trucks.....	15	2	3	12
Average annual miles per truck..	28,000	12,000	12,600	20,000
Average number of daily deliveries per truck.....	12	16	15	8
Average value of order delivered	\$83.33	\$100	\$105	\$86.75



*Exhibit IV*

## THE SILVER FAN MANUFACTURING COMPANY

## Warehouse Expenses

For the Year Ended December 31, 1962

	<i>Territory 1</i>	<i>Territory 2</i>	<i>Territory 3</i>	<i>Territory 4</i>
(Square feet).....	(22,000)	(16,000)	(24,000)	(19,000)
Variable expense (with sales):				
Salaries of storekeepers and material handlers.....	\$ 80,000	\$ 51,000	\$ 99,000	\$ 83,500
Fixed expenses:				
Depreciation of equipment (10%).....	8,000	7,200	9,100	7,800
Depreciation of warehouse (2%).....	6,000	5,400	7,500	6,300
Supervision.....	15,000	12,800	17,400	16,400
Clerical.....	9,000	6,300	12,600	10,500
Utilities.....	5,000	3,900	5,000	4,200
Taxes and insurance.....	5,000	3,800	5,100	4,900
Repairs and maintenance.....	14,000	6,400	17,400	9,300
Supplies and miscellaneous.....	10,000	8,200	9,900	7,100
Total.....	\$152,000	\$105,000	\$183,000	\$150,000

## 20. **Costs and Production Decisions**

In this chapter, we shall be concerned with the use of costs primarily as related to manufacturing decisions. The following types of decisions will be discussed:

Make or buy	Optimizing the production mix
Plant location	Selecting among alternative
Minimizing the inventory investment	raw materials
The cost of labor turnover	Selling or processing further

### *Make or buy*

Whether a company should make or buy materials, parts or completed products is a common type of business decision. The theory underlying make or buy decisions is neither ambiguous nor controversial. Making often entails a capital investment. A decision to make should take place whenever the expected cost savings provide a higher return on the required capital investment than can be obtained from employing these funds in an alternative investment bearing the same risk.

In practice, difficulties are encountered in identifying and estimating the relevant costs and in evaluating the noncost considerations. Oxenfeldt and Watkins, in their study of make or buy decisions, conclude that these decisions frequently are made upon insufficient, even insupportable grounds and that the resultant waste mounts up into hundreds of millions annually. They believe that most of it derives from making what could be more advantageously bought.<sup>1</sup>

### **The time span**

If little or no capital investment is required to make an item, the cost projections can be of short duration, perhaps for the coming year. In

<sup>1</sup> Alfred R. Oxenfeldt and Myron W. Watkins, *Make or Buy*, Consultant Reports on Current Business Problems (New York: McGraw-Hill Book Company, 1956). For similar conclusions, see also James W. Culliton, *Make or Buy* (Cambridge, Mass.: Harvard University Press, 1956).

such situations, it is relatively simple to convert from making to buying and vice versa. If making requires an investment in depreciable assets, the alternative costs should be projected over the life of the principal asset. At times it may be necessary to use a time period shorter than the normal life of the principal asset. This occurs whenever the life of the end product is expected to be shorter than that of the principal asset.

### Cost and noncost considerations

Fixed costs seldom remain unaffected by a decision to make a product. This particularly applies to management costs. The planning and supervision of a new manufacturing operation may divert present managers from other responsibilities or require additional supervisory personnel. These costs are somewhat difficult to quantify and all too often are ignored. With regard to sunk costs, it must be decided whether the existing space and facilities can be utilized by the company for other internal purposes, rented, or otherwise disposed of, and if so, what value they possess.

Imputed interest costs are important in make or buy decisions, particularly when large investments in facilities and inventories are required. Therefore, effect should be given to the time value of money by discounting the future cash flow.

Determining the purchase cost of an item generally presents fewer problems than determining the cost of manufacturing. The purchase cost equals the expected net supply price plus freight and incremental handling costs. Calculating the cost to make is more complicated. Consideration must be given to such factors as the quantity and types of items required to meet the production schedule; the facilities, space, and personnel needed; the best location for the "feeder" operation; and whether plant and facilities are available, should be purchased, or are to be obtained through merger with, or acquisition of, an existing firm.

In projecting labor costs, consideration should be given to such factors as the effect on the existing labor force; the condition of the local labor market and the availability of the type of laborer needed; probable labor cost trends, including fringe benefits; the amount of initial start-up losses due to inexperience; the level of output; and the productivity of labor.

Projecting raw materials costs entails a knowledge of probable market trends, expected level of production, type and quantity of raw materials required, availability of reliable suppliers, freight costs, discounts, order sizes, inventory balances, spoilage, rework, and waste allowances.

Each overhead cost should be predetermined separately. The common error of using existing plant- or department-overhead rates should be avoided. These rates are based on costs which were established at plant levels not pertinent to the proposal under consideration.

Many sources of information might be utilized for predicting cost trends. Statistics can be developed to show how supply prices have reacted in the past and to indicate the factors which induced price

changes. It may even be possible to develop a correlation between the supply price and one or more economic indicators. Statistical indices also may be utilized to show labor cost trends. Discussions with machinery salesmen, plant visitations, and even pilot plant operations may be used to estimate the cost of making.

The risk of miscalculation in a make or buy decision is great. The risk is greater when a long-term capital investment is involved. Risk creates a bias in favor of buying. The cost of risk may be recognized by establishing a high rate of return as the minimum rate for making.

Noncost considerations often assume primary importance in make or buy decisions. Some of the more common noncost factors are:

*In favor of making*

Instability of supply  
 Poor quality of supply  
 Desire to maintain secrecy  
 of process  
 Tax considerations  
 Idle facilities  
 Maintenance of labor force

*In favor of buying*

Lack of capital  
 Risk passed on to supplier  
 Lack of experience in making  
 Uneven production of end products  
 Wider selection  
 Special services furnished

### Illustration of a make or buy decision

In December, 1962, the purchasing agent of the Richtone Radio and Television Corporation was advised that the price of television screens for its portable model would be increased to \$5, the increase effective January 1, 1963. The purchasing agent believed that the price would continue to rise approximately 6 percent every 2 years. Before placing a large order for the coming year, it was decided to investigate the relative advantages of making the part instead of purchasing it. The president indicated that 20 percent was the minimum pretax rate of return that he considered acceptable. The following additional data were obtained:

1. According to the company's 1963 production schedule, 50,000 plastic screens would be required. Conservative predictions indicated that 55,000 parts would be needed in 1964; 60,000 in 1965; 60,000 in 1966; and 55,000 in 1967.

2. Two compression molding machines would be required to produce the minimum quantity required. Two used machines in good condition were located, with estimated 5-year lives. The machines would cost \$40,000 each, including transportation and installation. They have a combined annual output, after allowances for setup time and rejects, of 70,000 parts.

3. On the basis of test runs, it was determined that the plastic powder required to mold the screens would cost \$4 per screen in 1963. The purchasing agent indicated that a rise in the cost of plastic powder of approximately 5 percent could be expected every other year.

4. Two machine operators would be required at a combined annual cost, including fringe benefits, of \$15,000. Wage rates for this category of labor were expected to increase about 5 percent each year.

5. It was estimated that if the plastic screens were made, indirect-labor costs would rise by \$5,000 per annum plus 5 cents per part.

6. Other overhead costs expected to increase as a consequence of making the part were as follows:

Power.....	\$300 plus \$.006 per unit
Repairs.....	\$600 plus \$.004 per unit
Dies.....	\$2,000 plus \$.02 per unit
Insurance.....	\$300
Supplies.....	\$250 plus \$.003 per unit

7. The factory manager stated that the space that would be diverted to the new operation was worth \$50 a month.

Exhibit 20-1 presents the estimated net cash flow, exclusive of income taxes, for the years 1963 through 1967. Using the present-value table (Table II in the Appendix), it is apparent that the investment of \$80,000 will yield an expected return of 23.6 percent and that the company should make the part.

### Exhibit 20-1

#### RICHTONE RADIO AND TELEVISION COMPANY Make or Buy Projection

	1963	1964	1965	1966	1967
Estimated parts required	50,000	55,000	60,000	60,000	55,000
Estimated cost to buy	\$250,000	\$275,000	\$318,000	\$318,000	\$309,100
Estimated (cash) costs to make:					
Plastic powder	\$200,000	\$220,000	\$252,000	\$252,000	\$242,550
Direct labor	15,000	15,750	16,538	17,365	18,233
Indirect labor	7,500	7,750	8,000	8,000	7,750
Power	600	630	660	660	630
Repairs to machinery	800	820	840	840	820
Dies	3,000	3,100	3,200	3,200	3,100
Insurance	300	300	300	300	300
Supplies	400	415	430	430	415
Space lost	600	600	600	600	600
Total	\$228,200	\$249,365	\$282,568	\$283,395	\$274,398
Estimated net cash flow	\$ 21,800	\$ 25,635	\$ 35,432	\$ 34,605	\$ 34,702

From Table II, Appendix:

Present value of cash flow @ 22%.....	\$83,072
Present value of cash flow @ 24%.....	\$79,271
By interpolation, investment of \$80,000.....	23.6%



## *Plant location*

Selecting the location for a plant is an infrequent but significant type of decision. Although noncost factors frequently are decisive in choosing plant locations, more often than not a plant location study will reveal surprisingly large cost differences among alternative sites. "In many industries, a differential of as much as 10% of total manufacturing and distribution costs can be effected simply by virtue of geography."<sup>2</sup> These cost differentials are due to two factors: (1) the proximity of the site to raw materials sources or to customers and (2) cost differences traceable to the specific characteristics of an area, such as type of power available, climate, labor rates, construction costs, tax rates.

The choice of a location is influenced by the nature of the product and the types of activities conducted. If large, bulky raw materials are required and the finished product is relatively small, nearness to the source of raw materials may be imperative. If labor represents a particularly large portion of the total product cost, prevailing labor rates may be decisive in the selection of a site. A company producing an expensive and highly calibrated product may be less concerned with the wage scale than with the availability of skilled laborers, able to produce with a minimum of rejects.

The relative importance to the company of community characteristics, such as quality of the labor force, schools, cost of living, climate, transportation facilities, must be established. These basic requisites reduce the number of potential sites to be considered. When they have been satisfied, the geographically variable costs of those locations still under consideration can be examined in detail.

### **Transportation costs**

The early development of regional specialization in the United States largely can be attributed to the cost of transportation. The influence of transportation costs has diminished as product specialization has narrowed the span of manufacturing activities. Today, most concerns process items that already have been partially processed by other companies. The emphasis upon transportation costs largely has shifted from proximity to supply to closeness to market.

At the outset of a plant location study, it is necessary to establish the probable normal level of plant activity. At this level, the source, quantity, and average order size of each major raw material should be listed. Data also should be prepared showing the quantity of each type of finished product to be manufactured, the likely order size range, and the dispersion of customers. With this information, it is possible to decide which transportation facilities to use and to calculate the estimated transportation costs.

<sup>2</sup> Leonard C. Yaseen, *Plant Location* (New York: American Research Council, 1956), p. 5.

### Labor costs

A marked disparity in regional wage rates exists in the United States. Hourly wage rates for identical labor functions may vary as much as 50 percent in different parts of the country. Wage scales tend to be highest along the Pacific Coast and lowest in the South. The use of regional rather than local wage rates should be avoided in plant location studies, since noticeable rate differences occur even among neighboring cities.

There is a widely held belief that high wage rates are counterbalanced by increased labor productivity. This has never been conclusively demonstrated. On the contrary, empirical evidence exists which indicates that there is no close correlation between productivity and wage rates.<sup>3</sup>

It is necessary to estimate the annual hours of work for each labor classification at the expected level of operations. The total hours for each classification is then multiplied by the appropriate hourly rate. Provision also must be made for fringe benefits, which may range as high as 20 or 25 percent of the labor cost.

### Other relevant costs

While transportation and labor generally are the two most important cost elements in a plant location decision, other costs also may be sig-

<sup>3</sup> Ibid., p. 70.

### Exhibit 20-2

#### STYLECRAFT SHOE COMPANY Annual Differential Transportation Costs Torrington and Billingsford Sites

	<i>Estimated annual weight, lb</i>	<i>Average carload rates, per cwt</i>		<i>Estimated freight cost*</i>	
		<i>Torrington</i>	<i>Billingsford</i>	<i>Torrington</i>	<i>Billingsford</i>
Purchases:					
Raw material 1 .....	1,400,000	\$ 2.10	\$1.40	\$ 29,400	\$ 19,600
Raw material 2 .....	700,000	6.20	6.80	43,400	47,600
Raw material 3 .....	500,000	8.10	7.30	40,500	36,500
Total .....	2,600,000			\$113,300	\$103,700
Shipments:					
Sales district A .....	1,056,000	\$ 6.50	\$3.50	\$ 68,600	\$ 37,000
Sales district B .....	256,000	1.10	2.10	2,800	5,400
Sales district C .....	192,000	8.30	5.00	15,900	9,600
Sales district D .....	288,000	12.60	7.80	36,300	22,500
Total .....	1,792,000			\$123,600	\$ 74,500
Total freight cost .....				\$236,900	\$178,200

\* Figures rounded.

nificant. They include such items as power, light, heat, travel, taxes, and rent or amortization of building costs.

The type, adequacy, and cost of power should be investigated for each location. Power costs may be two or three times greater in some areas than others. Heating costs also fluctuate greatly because of weather conditions. Regional heating costs are calculated in terms of degree-days. A "degree-day" is defined as a departure of 1 degree per day in the mean daily temperature from a standard temperature, generally 65 degrees Fahrenheit. Today, higher heating costs in Northern climates tend to be offset by higher air-conditioning costs in Southern regions.

State and local taxes are a particularly important cost in plant location studies. Tax structures and rates vary markedly from state to state and city to city. Property taxes should be examined from the standpoint of the ratio between assessed and actual property values, as well as the

*Exhibit 20-3*

**STYLECRAFT SHOE COMPANY**  
Differential Labor Costs  
Torrington and Billingsford Sites

	<i>Projected annual hours</i>	<i>Hourly rate</i>		<i>Estimated annual labor cost*</i>	
		<i>Torrington</i>	<i>Billingsford</i>	<i>Torrington</i>	<i>Billingsford</i>
Direct labor:					
Cutting.....	20,800	\$2.48	\$2.60	\$ 51,600	\$ 54,100
Stitching.....	52,600	1.95	2.10	102,600	110,500
Fitting.....	24,400	2.15	2.30	52,500	56,100
Lasting.....	23,000	2.32	2.45	53,400	56,400
Bottoming.....	16,000	2.10	2.30	33,600	36,800
Trimming.....	13,900	1.86	2.00	25,900	27,800
Finishing.....	11,300	2.10	2.30	23,700	26,000
Packing.....	6,800	1.95	2.10	13,300	14,300
Total direct.....				\$356,600	\$382,000
Indirect labor:					
Material handling.....	27,100	1.40	1.48	\$ 37,900	\$ 40,100
Inspection.....	20,000	2.00	2.10	40,000	42,000
Maintenance.....	12,800	1.95	2.20	25,000	28,200
Supervision†.....	-0-	-0-	-0-	-0-	-0-
Receiving and storeskeeping.....	36,200	1.44	1.58	52,100	57,200
Watchman, janitors, etc.....	18,500	1.40	1.50	25,900	27,800
Office and clerical.....	26,600	1.50	1.65	39,900	43,900
Total indirect.....				\$220,800	\$239,200
Total direct and indirect.....				\$577,400	\$621,200

\* Figures rounded.

† No difference.

tax rates. Workmen's compensation rates differ greatly. For the same type of activity, they may range from \$2 to \$7 or more per \$100 of payroll. There also is a lack of uniformity in regard to franchise, income, stock transfer, sales, use, and gasoline taxes. For example, corporate income tax rates in Massachusetts are more than three times as great as in Missouri. Gasoline taxes range from 2 to 7 cents a gallon in different states.

### Illustration of a plant location study

The Stylecraft Shoe Company manufactures ladies shoes in its New England plant and sells these products throughout the United States. The growth trend during a 5-year period had been such that the plant, which was operating at full capacity, was having difficulty in meeting customer demands. Management, therefore, decided to establish additional manufacturing operations in the Middle West. Because of heavy long-term indebtedness, it was decided to rent rather than purchase the needed factory space. After considerable investigation of available factories, two plants, one at Torrington and the other at Billingsford, were considered equally attractive, from every standpoint except for operating costs.

The company uses three principal raw materials. The estimated transportation costs for the two locations appear in Exhibit 20-2. In Exhibit 20-3, the estimated annual labor costs are presented for each location. These and other differential costs are summarized in Exhibit 20-4. It is apparent that the Billingsford site is more advantageous. In this case, since no investment in plant is required and since machinery and other

#### Exhibit 20-4

### STYLECRAFT SHOE COMPANY Comparison of Projected Annual Differential Costs Torrington and Billingsford Sites

	<i>Torrington</i>	<i>Billingsford</i>
Transportation costs.....	\$236,900	\$178,200
Direct and indirect labor.....	577,400	621,200
Fringe benefits and payroll taxes.....	63,500	68,300
Workmen's compensation.....	21,400	19,400
Rent.....	10,000	12,000
State and local taxes.....	14,000	12,200
Power.....	21,500	14,300
Heat.....	4,500	3,200
Light.....	8,300	5,500
Water.....	800	700
Total.....	\$958,300	\$935,000
Annual cost differential in favor of Billingsford...		\$ 23,300



facilities would be the same regardless of the site selected, it is not necessary to give effect to the time value of money.

### *Minimizing the inventory investment*

Businessmen long have been aware of the importance of minimizing their inventory investment. This generally is accomplished by establishing an inventory control system based on a minimum protective stock or safety margin for each item plus a portion which varies with forecast sales and production. During recent years, efforts to control inventories have been greatly aided by the use of mathematical techniques, broadly referred to as *operations research*. These methods include linear programming, simulation, queuing theory, and statistical control charts.

#### **Factors affecting the size of inventories**

The size of inventories primarily is affected by three factors: (1) the amount of protective stock desired to avert "stockouts"; (2) the size of purchase orders placed; and (3) the size of factory lots processed. On the average, the raw materials inventory is equal to one-half the purchase order size and the finished goods inventory to one-half the size of lots processed in the factory.

The curves for ordering and start-up costs move in an opposite direction from the curve for the cost of carrying inventories. Processing or ordering in large quantities introduces unit cost economies, since it is possible to spread the same ordering and start-up costs over a larger number of units. However, this results in higher inventory levels and is counterbalanced by higher inventory carrying costs. The optimum inventory size is at that point at which these cost curves intersect or where the combined inventory cost of an item is at the lowest point.

#### **Relevant costs for determining optimum inventory size**

The costs relevant to establishing the optimum inventory size fall into two broad categories: (1) those which vary directly with the preparation and processing of purchase orders and size of lots processed and (2) cost of carrying inventories. Included in the first category are such costs as transportation, ordering, invoice processing, materials planning, factory setup, and learning time. In the second category are such costs as receiving and inspection, deterioration and obsolescence, space inventory record keeping, depreciation of facilities, insurance, taxes, and imputed interest on investment in inventories.

Inventory carrying costs may range from 15 to 25 percent of the total cost of inventories, depending upon the type and value of products, the kind of space and facilities used, the salaries of personnel, and the rate used for calculating the interest on investment. Exhibit 20-5 shows the inventory carrying costs of one concern, the American Machine and



## Exhibit 20-5

AMERICAN MACHINE AND FOUNDRY COMPANY  
Inventory Carrying Cost as an Annual Percentage  
(Cost of investment per dollar invested)

	<i>Percent</i>
Storage facilities (space cost) . . . . .	0.25
Insurance . . . . .	0.25
Taxes . . . . .	0.50
Supplies . . . . .	0.25
Handling and distribution . . . . .	2.00
Deterioration . . . . .	3.00
Interest . . . . .	5.00
Loss due to inability to invest funds in profit-making ventures . . . . .	8.00
Obsolescence . . . . .	5.00
Total . . . . .	<u>24.25</u>

SOURCE: John B. Holbrook, *Managing the Material Function—Tools, Techniques, and Company Practices: A Simple Tabular Method for Determining Economic Order Quantities*, American Management Association Report 35, New York, 1959, p. 64.

Foundry Company. Materials planning, ordering, and invoice-processing costs range from approximately \$4 to \$12 per order. This varies with the complexity of the product and the degree of mechanization of these functions. In determining the optimum order size, consideration also must be given to freight and purchase discounts, since they are both favorable to the larger order size.

Certain principles should be observed in selecting the relevant costs.

1. They should consist only of eliminable costs specifically applicable to the size of inventories. The salaries of personnel engaged in ordering, receiving, and storing merchandise are out-of-pocket costs. However, if these individuals will be retained in the same function, regardless of the number of orders placed, these costs are noneliminable and not relevant. Depreciation of equipment related to the receiving and maintenance of inventories is a sunk cost and should be ignored unless the investment in such facilities is directly affected by the size of inventories, i.e., through sale or purchase. Space costs should be included in the study only if the space can be profitably utilized for other purposes.

2. The rate of imputed interest applied to the investment in inventories should be based on alternative investment possibilities. The rate should not be applied against the *total* cost of the inventories carried but only against that portion of the cost which represents *out-of-pocket* and eliminable expenditures. Only the latter costs affect the incremental capital investment. Thus, depreciation and supervision costs included in the inventory should be extracted before applying the imputed interest rate.

The inventory cycle, under ideal circumstances, is illustrated in Fig.

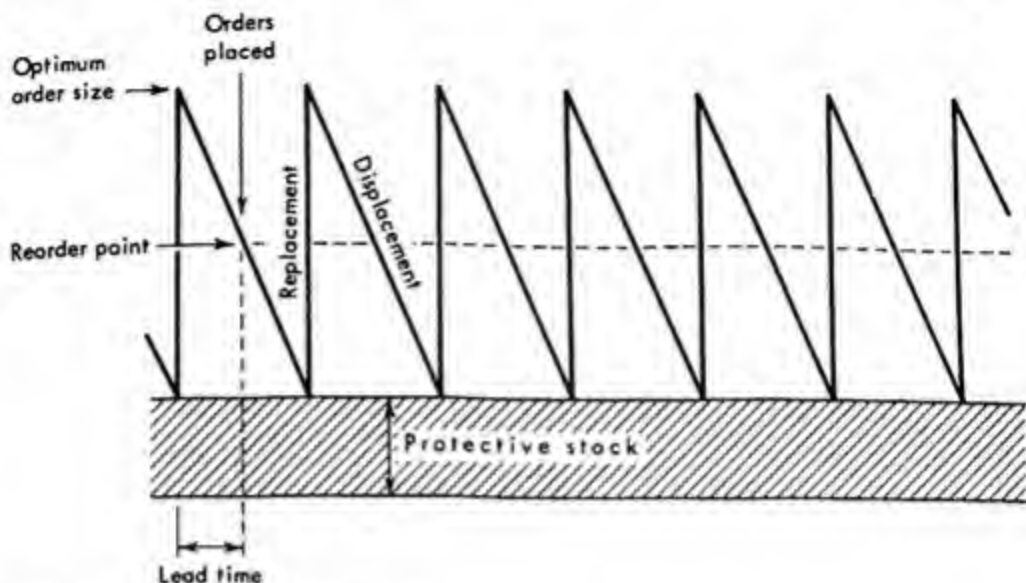


Fig. 20-1 The inventory cycle.

20-1. Each of the elements shown, i.e., protective stock, optimum order size, lead time, and reorder point, will be discussed separately.

### Establishing the level of protective stock

It is advisable to segregate the inventory into high- and low-value items. Frequently, it will be found that 70 to 80 percent of the inventory value consists of 10 to 20 percent of the items numerically. Generally, it is not necessary to establish optimum inventory levels for the low-value items. Since the value of these items is relatively low, they can be controlled by maintaining high protective margins. Mathematical techniques then can be applied to the remaining high-value items.

Determining the level of protective stock to be maintained involves an evaluation of the risk of stockouts and the potential costs or losses attributable to them. Normally, it is not economical to establish a protective level for finished goods which is designed to prevent stockouts entirely. This would entail maintaining an excessive inventory investment. Rather, the objective should be to maintain a protective stock which permits some stockouts, provided the expected losses from stockouts do not exceed the cost of carrying additional inventories to prevent their occurrence.

A procedure for establishing the protective level is suggested in Exhibit 20-6. The average weekly inventory level during the preceding year, for a particular product, is shown in column 1 and the frequency of occurrence in column 2. The time-weighted inventory level appears in column 3. The number of stockouts is shown in column 4 and the percentage of stockouts in column 5. By analyzing these data and attaching a cost to stockouts, e.g., special-delivery charges, loss of profits on canceled orders, loss of customer, management can decide what risk it is willing to assume and establish an appropriate protective stock level.

Exhibit 20-6

## Procedure for Determining the Level of Protective Stock

(1)	(2)	(3)	(4)	(5)
<i>Inventory level, units</i>	<i>Frequency of occurrence, no. of weeks</i>	<i>Time-weighted inventory level</i>	<i>Number of stockouts</i>	<i>Stockouts, %</i>
1,000	3	3,000	30	1.0
2,000	11	22,000	22	.1
3,000	12	36,000	10	.028
4,000	13	52,000	5	.01
5,000	8	40,000	2	.005
6,000	5	30,000	1	.003
Total . . . . .	52	183,000	70	

**Determining the optimum order quantity**

A number of formulas have been developed to calculate the optimum order quantity or economical lot size. One of the oldest and simplest is,

$$OQ = \sqrt{\frac{2RS}{KC}}$$

where  $OQ$  = order quantity (or economic lot size)

$R$  = annual usage (or sales)

$S$  = cost of placing an order (or setup)

$C$  = cost per unit

$K$  = inventory carrying cost as a percentage of total cost

The derivation of this formula is explained in the discussion which follows.

1. Eliminable ordering costs are a constant dollar figure per order. If a company desires to fill its annual requirement of an item with a large number of small orders, rather than a single large order, its total ordering costs will be greater. The total annual ordering costs may be expressed by the equation

$$A = S \frac{R}{OQ}$$

where  $A$  = total annual ordering costs

$S$  = ordering cost per order

$R$  = annual requirement of an item

$OQ$  = size of order

2. Eliminable inventory carrying costs may be expressed as a percentage of the inventory investment. Since raw materials inventory is equal to one-half the size of purchase orders, the average investment in raw materials decreases with the number of orders placed to fill a given

annual requirement. Therefore, total annual inventory carrying costs decline as the size of orders is decreased. This is reflected in the following equation:

$$A' = KC \frac{OQ}{2}$$

where  $A'$  = total annual inventory carrying costs

$K$  = percent of cost of an item represented by inventory carrying charges

$C$  = cost of item

$OQ$  = size of order

$\frac{OQ}{2}$  = average inventory investment, units

3. In Fig. 20-2, the combined annual ordering and carrying costs are lowest when the two cost curves intersect, or when  $A' = A$ . Thus,

$$KC \frac{OQ}{2} = S \frac{R}{OQ}$$

$$KC \frac{OQ}{2} = \frac{RS}{OQ}$$

$$KC(OQ)^2 = 2RS$$

$$(OQ)^2 = \frac{2RS}{KC}$$

$$OQ = \sqrt{\frac{2RS}{KC}}$$

The approximate accuracy of the formula may be demonstrated by assuming that a company's annual requirement of an item costing 30 cents is 8,000 units, the ordering cost per order is \$7, and the carrying cost 15 percent of the cost of the item. As shown in Exhibit 20-7, the op-

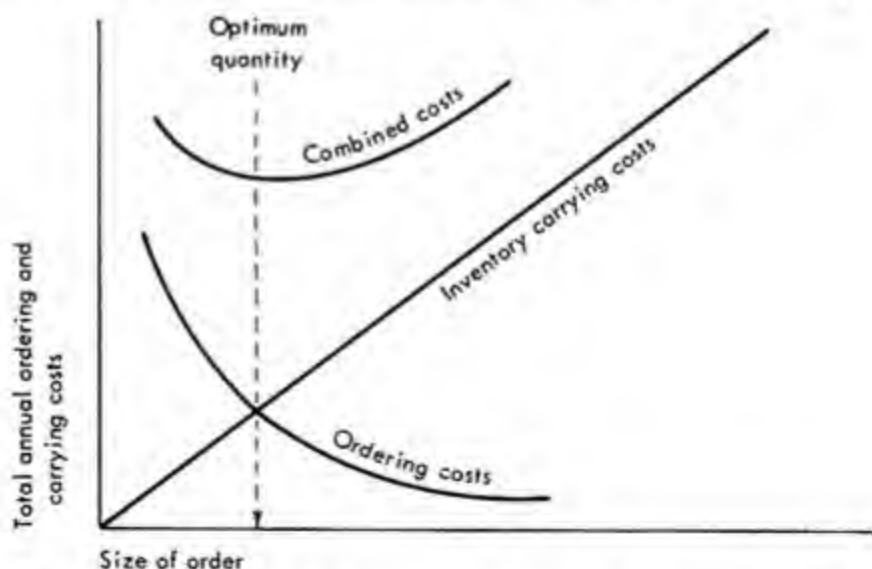


Fig. 20-2 Relation of inventory ordering and carrying costs to size of order.

## Exhibit 20-7

## Determining the Optimum Order Size

<i>Orders placed</i>	<i>Units per order</i>	<i>Total ordering costs</i>	<i>Total carrying costs*</i>	<i>Combined costs</i>
1	8,000	\$ 7	\$180	\$187
2	4,000	14	90	104
3	2,667	21	60	81
4	2,000	28	45	73
5†	1,600	35	36	71
6	1,333	42	30	72
7	1,143	49	26	75
8	1,000	56	22	78

\* 15% of average inventory investment (one-half of dollar value of order).

† OQ is 5 orders, 1,600 units per order.

timum number of units to order is 1,600 (five orders). Using the formula, the optimum number is

$$\sqrt{\frac{2 \times 7 \times 8,000}{.30 \times .15}} = 1,581$$

## Timing the reorder

Having established the economical order quantity and the protective stock margin in the manner described, we now are interested in determining when to reorder. In order to accomplish this, it is necessary to know the lead time, or time required to obtain delivery after an order has been placed. This, of course, varies with the location of suppliers, the complexity of the product, and whether it is stocked by the supplier or must be specially fabricated. The purchasing department is the source for this information. Let us assume that the lead time is established at 1 month, that a protective stock of 500 units is desired, and that annual usage is estimated as follows:

<i>Month</i>	<i>Units</i>
January.....	1,900
February.....	2,200
March.....	1,700
April.....	1,700
May.....	1,700
June.....	1,800
July.....	1,500
August.....	1,500
September.....	1,800
October.....	2,300
November.....	2,400
December.....	2,300
Total.....	22,800
Average per month.....	1,900



Based on the foregoing data, the reorder point may be calculated as shown below:

	<i>Units</i>
Protective stock.....	500
Average demand during lead time.....	1,900
Reorder point.....	<u>2,400</u>

If monthly usage fluctuates sharply, the use of average demand may dip into the protective stock. For example, if the reorder point is established at 2,400 units, by the end of November the protective stock margin will have been exhausted. This can be averted by basing the reorder point on expected demand during the forthcoming month instead of on average monthly demand.

### The usefulness of mathematical methods for minimizing the inventory investment

The mathematical methods for minimizing the inventory investment have their greatest applicability among large companies, where the value of items is so large that the cost of employing scientific methods is more than offset by the resultant economies. Many large companies employing mathematical inventory control methods in conjunction with electronic data processing have achieved substantial cost savings. However, it should be recognized that the number of variables generally are greater than indicated by the relatively simple formula discussed. Where these additional variables are both predictable and consistent, the basic formula can be elaborated. However, the formulas can become too cumbersome for use other than by computers. In some cases, mathematicians have constructed tables, nomographs, and even special slide rules which give effect to additional variables, particularly purchase discount. For the following reasons, whatever formulas are used should be reviewed frequently.

1. Determining inventory carrying costs, setup costs, and ordering costs is not a simple matter and may vary from item to item and plant to plant. More expensive items require higher insurance rates. Larger products need more space and require more handling. More complicated products involve higher ordering costs.

2. Purchase discounts may vary at different ordering levels and among different suppliers.

3. Freight differentials vary with the source of supply and the distances involved.

4. Space limitations, particularly for large bulky items, may modify the results.

5. Purchase prices may fluctuate seasonally.

6. Other considerations, such as the need for maintaining the existing labor force or desire to obtain shift economics, may require inventory build-ups.

The economics of inventory control suggest that accountants have

been mistaken in their general emphasis on high inventory turnover rates. Higher inventory turnover is obtained by reducing the inventory investment in relation to cost of sales. It is clear from Fig. 20-2 that reductions in the average inventory investment beyond a certain point increase rather than decrease the combined inventory carrying and ordering costs.

### *The cost of labor turnover*

It has been estimated that the annual cost of labor turnover in the United States is in excess of \$11 billion.<sup>1</sup> It is not surprising that labor economists and personnel administrators have devoted considerable attention to the subject. As a consequence of these efforts, notable refinements have taken place in the conceptual framework and in the methodology for calculating labor turnover. It would seem that the impact of the cost of labor turnover on profits also would be of major concern to accountants. In fact, the subject has been ignored in the literature of accounting.

Divergent viewpoints exist as to the definitions and methods of calculating the rate and cost of labor turnover. It is not possible in this brief presentation to present a comprehensive discussion of the subject. Rather, it is possible only to indicate the nature and importance of the problem and to suggest how the accountant can accumulate and present meaningful data.

There are two general methods for determining the cost of labor turnover, the *separation and replacement method* and the *profit forgone method*. In the separation and replacement method, the specific costs applicable to separatees and their replacements are accumulated. In the profit forgone method, the actual profit for the period is compared with the estimated profit that would have been obtained had no labor turnover occurred. The difference represents the profit lost as a consequence of labor turnover.

The separation and replacement method is more commonly used in the United States, whereas the profit forgone method is widely used in England, Australia, and other Commonwealth nations. When used separately, each of these methods has certain limitations. Accordingly, in the illustration that follows there is an attempt to combine the two methods.

#### **Labor turnover rates**

Turnover rates are useful in focusing attention on troublesome labor situations. Many different labor turnover rates are used in practice. One

<sup>1</sup> Frederick J. Gaudet, *Labor Turnover*, American Management Association, Research Report 39, New York, 1960, p. 37.

common formula is

$$LT = \frac{S}{N} \times 100$$

where  $S$  = separations

$N$  = average number of employees

Turnover rates also may be calculated according to sex, age, number of years of service, etc. Frequently, efforts will be made to correlate labor turnover with wage scale, accident rates, or other potential causes of labor turnover.

### Separation and replacement costs

**Separation costs.** Many companies have a formal interview procedure for separatees to determine the reasons for their leaving. The interviewer's time constitutes a direct charge against the labor classification involved. Severance pay often is required by union contract, the amount varying with the type of work and the length of service with the company.

With regard to social security, the company is liable for the tax at the current rate, but not in excess of \$4,200 of the gross earnings of each employee. However, if a worker is replaced, the tax liability begins anew. Thus, as a consequence of a separation, it is possible for the company's social security tax on a worker and his replacement to be based on amounts ranging to \$8,400 instead of \$4,200. In states where the unemployment tax rate is based on a merit rating system, high turnover rates introduce higher unemployment compensation taxes. It is possible to prepare tables which show the effect of different turnover rates on the unemployment compensation tax and the cost per separatee.<sup>5</sup>

**Recruitment costs.** It is common for companies to advertise for personnel. The type and cost of the advertising varies with the degree of skill required and the availability of potential candidates. Brochures, pamphlets, and other printed material may be prepared to familiarize applicants with the nature of the company and its employment policies.

Representatives of many of the large companies visit college campuses to interview graduating seniors. These visits generally are for the purpose of obtaining technical or junior executive personnel. The cost of the interviewer's time, traveling, and entertainment should be charged to the applicable labor categories. Some companies use the services of employment agencies, particularly for skilled or technical personnel. In such cases, it is not unusual for the company to pay the agency fee.

**Selection costs.** The type of employment interview varies with the nature of the position under consideration. Generally, it is impractical to maintain records for an expense of this kind. Rather, allocation of interviewing costs may be on the basis of an estimate of the number of interviews and the average length of time required. The cost of reference

<sup>5</sup> Grant W. Canfield, *Personnel*, November-December, 1958, p. 85. (Letter to the editor.)

checking includes telephone, telegraph, correspondence time, and occasional travel. Some companies reimburse out-of-town applicants for traveling expenses. Many companies require their employees to undergo a medical examination. Since a company's own medical facilities would be used also by regular employees, it is necessary to allocate the cost of maintaining this facility among the different users.

**Training costs.** The procedure for training new employees generally involves either a vestibule school or on-the-job training. If the former is used, the portion of the cost of the training school applicable to replacements should be allocated to the different labor categories on the basis of the number of individuals trained. This cost includes space charges of the school, depreciation of facilities, salaries of instructors, and materials consumed.

If on-the-job training takes place, the cost includes the time expended by the instructor and the cost of defective goods. Not all the training time is unproductive. A learning curve exists, and as the trainee gains experience, his productivity increases. Training costs should be offset by the cost of acceptable items produced.

### Illustration of the determination of the cost of labor turnover

The income statement of the Loomtex Corporation for the year ended December 31, 1962, appears in Exhibit 20-8.

### Calculating the profit forgone as a result of labor turnover

The total number of actual hours worked by direct laborers of the Loomtex Corporation was 2,060,000. As a consequence of delays in fill-

#### Exhibit 20-8

#### LOOMTEX CORPORATION

#### Income Statement

For the Year Ended December 31, 1962

Sales.....		\$24,000,000
Less: Variable costs.....		
Materials.....	\$6,010,000	
Direct labor.....	5,190,000	
Variable factory overhead.....	3,200,000	
Variable selling and administrative expense.....	1,900,000	
Total variable costs.....		16,300,000
Contribution to fixed overhead and profit.....		\$ 7,700,000
Less: Fixed overhead.....		5,300,000
Profit before taxes.....		\$ 2,400,000
Capital investment.....		\$12,000,000
Return on sales.....		10.0%
Capital turnover.....		2.0
Return on capital.....		20.0%



ing positions of employees who were discharged or who quit, 60,000 potentially productive hours were not worked, and included in the total actual hours worked were 40,000 applicable to training replacements for separatees. Half of the training hours were unproductive, as shown below:

	<i>Total training hours</i>	<i>Unproductive hours</i>
Employees remaining for 3 weeks' training.....	32,000	14,400
Employees leaving in less than 2 weeks.....	6,400	4,000
Employees leaving in less than 1 week.....	1,600	1,600
Total.....	40,000	20,000

The direct costs incurred by the Loomtex Corporation as a consequence of labor separations and replacements were as follows: separation costs, \$25,630; recruitment costs, \$23,140; selection costs, \$32,080; and training costs, \$31,160.

The procedure for calculating the profit forgone as a consequence of labor turnover, assuming that items produced can be sold at prevailing prices, is as follows:

(1) Actual hours of direct labor.....	2,060,000
Less: Unproductive hours of trainees.....	20,000
Actual productive hours of direct labor.....	2,040,000
Sales.....	\$24,000,000
Sales value per productive direct-labor hour.....	\$11.76

(2) Assuming that the potential production lost as a consequence of labor turnover could have been sold, the lost sales are equal to \$940,800, calculated as follows:

Hours lost in finding replacements.....	60,000
Training hours lost.....	20,000
Total lost hours.....	80,000
Multiplied by sales value per productive labor hour.....	×\$11.76
Potential sales lost.....	\$940,800

(3) The estimated effect on direct-labor cost if no labor turnover had occurred is:

Actual direct-labor cost.....	\$ 5,190,000
Add: Hours lost because of delays in filling positions of separatees.....	60,000
Multiplied by average hourly rate.....	×\$2.52
Direct-labor cost if no direct-labor turnover had occurred.....	\$5,341,200



(4) The estimated effect on variable costs if no labor turnover had taken place is shown below:

Variable costs other than direct labor.....	\$11,110,000
Add: Increase in variable costs, other than direct labor, with increase in potential sales lost (\$11,110,000/\$24,000,000) × \$940,800.....	435,496
Variable costs, other than direct labor, at sales volume that would have been attained with no labor turnover.....	\$11,545,496

A comparison of the actual profit and the profit that would have been attained had no labor turnover taken place appears in Exhibit 20-9.

### Reducing labor turnover

Labor turnover is caused by both external and internal factors. The external influences, e.g., cyclic conditions, weather, strength of unions, seasonal sales, community living conditions, are largely beyond the con-

Exhibit 20-9

### LOOMTEX CORPORATION Comparison between Actual Income and Potential Income With No Labor Turnover Year Ended December 31, 1962

	Actual [from Exhibit 20-8]	Estimated, with no labor turnover
Sales.....	\$24,000,000	\$24,940,800
Less: Variable costs		
Direct labor.....	\$ 5,190,000	\$ 5,341,200
Other variable costs.....	11,110,000	11,545,496
Total variable costs.....	\$16,300,000	\$16,886,696
Contribution to fixed overhead and profit.....	\$ 7,700,000	\$ 8,054,104
Less: Fixed costs.....	5,300,000	5,300,000
		\$ 2,754,104
Add: Elimination of separation and replacement costs		
Separation.....		\$ 25,630
Recruitment.....		23,140
Selection.....		32,080
Training.....		31,160
Total separation and replacement costs.....		\$ 112,010
Profit before income tax.....	\$ 2,400,000	\$ 2,866,114
Return on sales.....	10.0%	11.5%
Capital turnover.....	2.0	2.08
Return on capital.....	20.0%	23.9%

trol of a company. The internal factors, e.g., rates of pay, ratio of women employees, working conditions, type of supervision, training program, are not always easy to pinpoint.

Several techniques may be employed to determine the causes of labor turnover, including on-the-job interviews, an employee suggestions system, psychological testing, and exit interviews. Corrective action should be evaluated by comparing the required cost outlays with the expected recoupment of profits.

### *Optimizing the production mix*

Economics largely is concerned with alternative uses of limited resources. In a business, these resources include working capital, factory and warehouse space, available labor, machine capacity, and raw materials. Sometimes, the number of possible combinations is so great that profit maximization can be achieved only through the use of mathematics, particularly linear programming. In the illustration of linear programming which follows, the number of variables is sufficiently limited so that profit maximization can be derived graphically instead of through the more involved algebraic methods.

#### **Illustration of optimization of production mix**

The Robinson Company, a small but successful metalworking plant, is planning an expansion program. Until the program is complete, factory

**Exhibit 20-10**

#### **THE ROBINSON COMPANY** Product Contribution Margin

	<i>Product X</i>			<i>Product Y</i>		
	<i>Hours per unit</i>	<i>Rate per hour</i>	<i>Direct- labor cost</i>	<i>Hours per unit</i>	<i>Rate per hour</i>	<i>Direct- labor cost</i>
Stamping department.....	.20	\$2.50	\$ .50	.25	\$2.50	\$ .63
Cutting department.....	.80	2.00	1.60	2.00	2.00	4.00
Welding department.....	.10	2.25	.23	.20	2.25	.45
Total.....			\$2.33			\$5.08
Selling price.....	\$15.00			\$30.00		
Variable costs:						
Direct labor.....	\$ 2.33			\$ 5.08		
Other variable costs.....	6.67			6.92		
Total variable costs.....	\$ 9.00			\$12.00		
Contribution margin.....	\$ 6.00			\$18.00		

Exhibit 20-11

**THE ROBINSON COMPANY**  
Maximum Production—Items X and Y

Department	Department capacity, hr	Maximum production	
		Item X	Item Y
Stamping .....	1,100	5,500	4,400
Cutting .....	4,800	6,000	2,400
Welding .....	650	6,500	3,250

capacity is insufficient to meet the sales demand. In scheduling production for the coming month, the company desires to produce quantities of its two products X and Y so that profits will be maximized. The three departments with production constraints, i.e., limits, are stamping (1,100 hours), cutting (4,800 hours), and welding (650 hours). The contribution margin for products X and Y is shown in Exhibit 20-10. The maximum production of item X or Y that can be obtained in each department,

Units of Product X

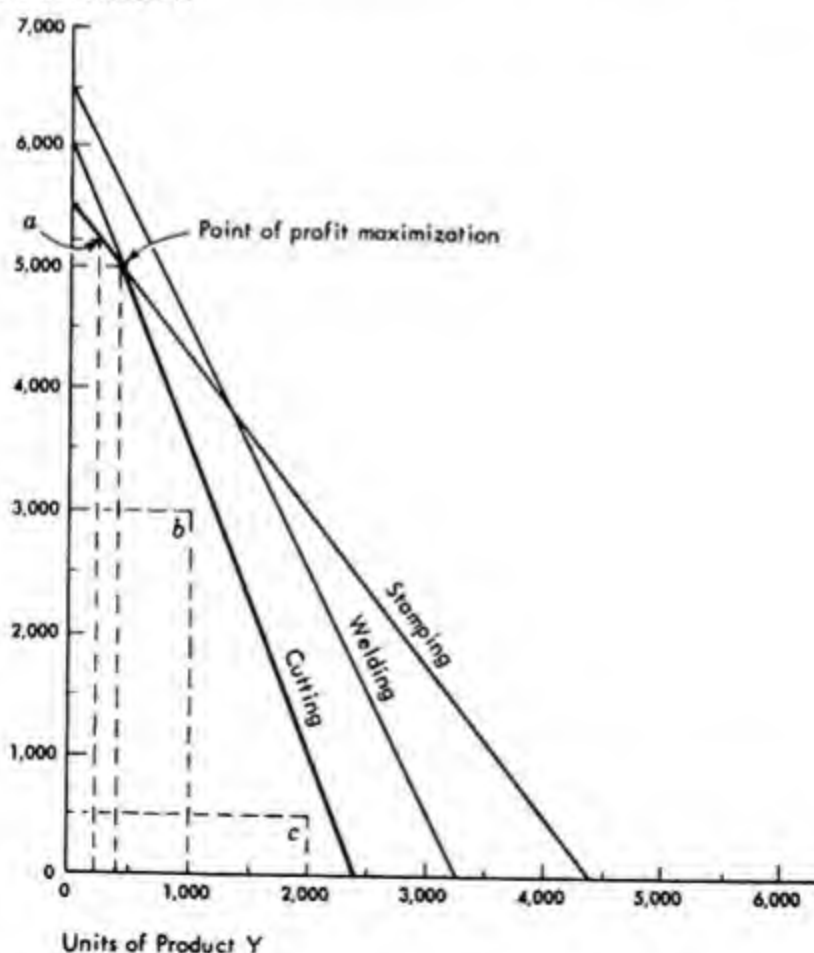


Fig. 20-3 Selection of optimum production mix.

e.g., product X—stamping (1,100/.20, or 5,500), is shown in Exhibit 20-11.

In Fig. 20-3, the production of X is plotted on the vertical axis and Y on the horizontal axis. Straight lines are drawn to designate the production possibilities in each department. The stamping department can produce 5,500 units of X or 4,400 units of Y, or any intermediate combination. It can also produce less than these quantities but will then have unused capacity. The optimum production combination must lie within the area from the origin to the heavy line. Beyond this line, the capacity of either the stamping or cutting departments will be exceeded. Points *a*, *b*, and *c* represent possible production schedules (incremental profits of \$34,800, \$36,000, and \$37,800, respectively). Profit maximization occurs where the lines for the two departments, stamping and cutting, intersect. At this point, 5,000 units of X and 500 units of Y can be produced with a resultant incremental profit of \$39,000.

### *Selecting among alternative raw materials*

A common type of management decision is one which involves a choice between two or more raw materials where the quality of the finished product is not affected. The variables which may influence the choice are purchase price, processing costs, and the yield of finished items.

#### *Illustration of selecting among alternative materials*

The Optik-Lab manufactures optical lenses according to prescriptions received from optometrists and opticians. The processing of lenses involves the following operations: selection of blanks, marking axis, blocking, cutting curvature, fining, polishing, chilling, separating, inspecting, and packing. Generally, orders must be shipped within 24 hours from receipt. Although this occasionally results in slack days, the plant generally operates at close to capacity.

The polishing department consists of 20 machines, which are operated by five workers. The combined annual gross pay of these polishers amounts to \$27,000. Fringe benefits are equal to 15 percent of the labor cost. Variable polishing overhead amounts to 20 percent of the polishing direct labor. Each machine contains four rotating spindles on which polishing pads are glued. The pads are replaced after each run. A lens is locked in a machine tool and pressed against the rotating spindle. As the spindle rotates, the polishing pads are soaked by a continuous spray of polishing mixture.

Two rare earth compounds, zirconium oxide and cerium oxide, may be used for polishing. Zirconium oxide costs 95 cents a pound and cerium oxide \$1.95 a pound. The company has been obtaining satisfactory polishing results from the use of the less expensive compound. Approximately 2,800 pounds of zirconium oxide are used annually.

It was decided to conduct a series of experiments to determine which

*Exhibit 20-12*

**THE OPTIK-LAB**  
**Results of Test of Polishing Powder\***  
**Average Time Required for Lens to Pass Inspection**

<i>Compound</i>	<i>4 oz of polishing powder, min</i>	<i>8 oz of polishing powder, min</i>	<i>12 oz of polishing powder, min</i>
Zirconium oxide.....	18	20	20
Cerium oxide.....	13	14	15

\* These figures should not be regarded as indicative of the relative merits of the two competing products. The actual results of the tests are part of a monograph by Morton Backer, *Study of Polishing Costs in an Optical Laboratory*, W. R. Grace & Company, Davison Chemical Division, New York, 1961.

*Exhibit 20-13*

**THE OPTIK-LAB**  
**Estimated Annual Savings**  
**Resulting from Test of Polishing Powders**

Present polishing labor cost.....	\$27,000	
Labor savings (35%).....		\$ 9,450
Fringe benefits (15%).....		1,420
Polishing overhead eliminable with reduction in labor (20% of \$9,450).....		1,890
Total.....		12,760
Less: Differential cost of powder		
Cost of cerium oxide (1,400 lb @ \$1.95).....	\$ 2,730	
Cost of zirconium oxide (2,800 lb @ \$.95).....	2,660	70
Total estimated annual saving.....		<u>\$12,690</u>

of the two available polishing powders was more economical. This involved measuring the two variables, the quantity of each polishing powder required and the polishing time cycle. The polishing department had been using a mixture of 8 ounces of cerium oxide to 48 ounces of water. The polishing time cycle was controlled by an automatic timer and lasted 20 minutes. In the experiment, the water was held constant, i.e., at 48 ounces, but the polishing powders were varied at 4, 8, and 12 ounces. The results of the test are shown in Exhibit 20-12.

The tests indicated that by using the more expensive cerium oxide, the 20-minute present time cycle could be reduced to 13 minutes. This represents an estimated annual saving of approximately \$12,690, as shown in Exhibit 20-13.

### **Raw materials selection, processing costs, and product yields**

In some industries, particularly those characterized by joint costs, the yield of finished products depends to a large extent upon the types of



Exhibit 20-14

THE SEABOARD OIL COMPANY  
Crude Oil Yields\*  
(Based on 20,000-barrel throughput)

	Crude 1		Crude 2		Crude 3		Crude 4		Crude 5	
	Bbl	Gal	Bbl	Gal	Bbl	Gal	Bbl	Gal	Bbl	Gal
Loss.....	520	21,840	600	25,200	720	30,240	620	26,040	300	12,600
Regular motor gasoline.....	1,540	64,680	5,140	215,880	5,560	233,520	6,620	278,040	7,020	294,840
Premium motor gasoline.....	3,840	161,280	4,040	169,680	3,440	144,480	3,620	152,040	920	38,610
Kerosene.....	-0-	-0-	-0-	-0-	-0-	-0-	2,740	115,080	2,560	107,520
Diesel oil.....	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
No. 2 distillate.....	2,180	91,560	3,140	131,880	2,600	109,200	1,000	42,000	920	38,640
No. 3 distillate.....	1,240	52,080	1,180	49,560	980	41,160	1,040	43,680	300	12,600
Lubricating oil.....	-0-	-0-	-0-	-0-	-0-	-0-	680	28,560	6,020	252,840
Fuel oil.....	10,680	448,560	5,900	247,800	6,700	281,400	3,680	154,560	1,960	82,320
Total.....	20,000	840,000	20,000	840,000	20,000	840,000	20,000	840,000	20,000	840,000

\* 42 gal per bbl.

raw materials used. In the oil-refining industry, processing costs as well as finished stock yields vary with the type of crude oil used. In order to maximize profits, a number of variables must be considered. They include the price of crude at the wellhead, transportation to the refinery, refinery processing costs, available capacity, crude yields, and selling prices of finished stock.

The cost of crude oil generally ranges from 70 to 85 percent of total refinery costs. Crude oil prices vary by type, weight, and location. At the well the price of crude oil of the same gravity may run from \$1.80 (Middle East) to \$4.50 (Pennsylvania). Low-gravity crudes ordinarily cost less, because they contain a large amount of sulfur which must be removed and gas oil which must be cracked to yield high-octane gasoline.

### Illustration of the relationship among raw materials, processing costs, and product yields

The Seaboard Oil Company, which operates a small refinery with a 20,000 daily throughput capacity, sells its finished products to independent distributors. Its entire production can be disposed of at the prevailing market prices. Crude oil is plentiful, and the company's major problem is to select the crude oil which will maximize its profits. Five different crudes are under consideration with yields as shown in Exhibit 20-14. The marginal cost per barrel appears in Exhibit 20-15, and the estimated marginal income for each crude is presented in Exhibit 20-16.

It is apparent (Exhibit 20-16) that crude 5 is most profitable for the company. Selling prices of refined products do not remain constant, and as they change, the results obtained will have to be modified. In actual practice, nonquantitative considerations assume far greater importance

Exhibit 20-15

#### THE SEABOARD OIL COMPANY Estimated Daily Marginal Throughput Costs per Barrel for Crude Oils under Consideration

	Crude 1	Crude 2	Crude 3	Crude 4	Crude 5
Delivered cost of crude oil.....	\$3.110	\$3.520	\$2.410	\$4.550	\$5.830
Processing costs:					
General labor.....	.127	.199	.189	.232	.258
Sulfur and sourness penalty..	.201	.284	.252	-0-	-0-
Fuel, power, and water.....	.120	.186	.174	.214	.238
Cracking.....	.202	.216	.183	.192	.051
Gasoline upgrading.....	.030	.194	.250	.285	.462
Taxes.....	.090	.106	.105	.117	.154
Miscellaneous.....	.042	.057	.055	.049	.054
Total marginal throughput costs per bbl.....	\$3.922	\$4.762	\$3.618	\$5.639	\$7.047

## Exhibit 20-16

**THE SEABOARD OIL COMPANY**  
**Estimated Daily Marginal Income for Crude Oils under Consideration**

	<i>Market price per gal</i>	<i>Crude 1</i>	<i>Crude 2</i>	<i>Crude 3</i>	<i>Crude 4</i>	<i>Crude 5</i>
<b>Revenue:</b>						
Regular motor gasoline...	\$ .112	\$ 7,244	\$ 24,179	\$26,154	\$ 31,141	\$ 33,022
Premium motor gasoline...	.121	19,515	20,531	17,482	18,397	4,675
Kerosene.....	.100	-0-	-0-	-0-	11,508	10,752
Diesel oil.....	.086	-0-	-0-	-0-	-0-	-0-
No. 2 distillate.....	.101	9,248	13,320	11,029	4,242	3,903
No. 3 distillate.....	.096	5,000	4,758	3,951	4,193	1,210
Lubricating oil.....	.620	-0-	-0-	-0-	17,707	156,761
Fuel oil.....	.066	29,605	16,355	18,572	10,201	5,433
Total revenue.....		\$70,612	\$ 79,143	\$77,188	\$ 97,389	\$215,756
<b>Less: Throughput costs</b>						
(from Exhibit 20-15)						
× 20,000.....		78,440	95,240	72,360	112,780	140,940
Marginal income.....		\$(7,828)	\$(16,097)	\$ 4,828	\$(15,391)	\$ 74,816

than suggested in our illustration. They include the importance of maintaining a reliable supply of crude, the different types of crude available, the nature of the distribution channels, and the flexibility of the refinery.

### *Selling or processing further*

The question of whether to sell an item at an intermediate stage or to process it further is a frequent type of managerial decision. An integrated textile company can sell yarn or weave it into cloth, can sell the cloth or produce clothing. A meat packer can sell pork, cure it, or smoke it. A refinery can sell fuel oil and kerosene or crack them into high-octane gasoline.

If further processing entails additional facilities, one is, of course, confronted with a capital-investment decision. Assuming, however, that facilities already exist, the decision hinges on a comparison between the additional, or incremental, revenue which is obtainable and the costs to be incurred. Since this type of decision is common in joint cost industries, it should be remembered that the costs allocated to the product for the purpose of income measurement are irrelevant.

### **Illustration of selling or processing further**

Let us assume that a company manufactures three products and allocates joint costs as indicated on the following page.

Product	Production	Selling price	Sales value of production	Allocation of joint costs	Unit cost
A	10,000	\$2	\$ 20,000	\$ 16,000	\$1.60
B	20,000	3	60,000	48,000	2.40
C	30,000	4	120,000	96,000	3.20
Total			\$200,000	\$160,000	

Suppose that it is possible by additional processing to convert 10,000 units of A into 5,000 units of D. The additional processing costs are estimated at \$7,000, and the market price of a unit of D is \$6. Assuming that the company can sell the 5,000 units of D, it is more profitable to process than to sell, as indicated below:

Incremental revenue:	
Product D (5,000 @ \$6)	\$30,000
Less: Product A (10,000 @ \$2)	20,000
Difference	\$10,000
Less: Incremental costs	7,000
Incremental profit from processing further	<u>\$ 3,000</u>

## Problems and cases

- 20-1 *Make or buy; relevant costs.* The Texas Nut and Bolt Company is considering the purchase of part X, which is at present being manufactured. The manager of the purchasing department has concluded a study of the comparative costs of making versus buying. Included in the study is an item of \$1,425 in favor of buying. This represents a savings in purchase department costs, calculated as follows. Comment on the procedure.

Total Annual Purchasing Costs	
Space	\$ 8,000
Utilities	3,900
Depreciation of office machinery	1,600
Supplies	19,000
Salaries	110,000
Total purchasing costs	<u>\$142,500</u>
Total purchases	<u>\$400,000</u>
Purchases—part X	\$400,000
Percent to total purchases	1%
Reduction in purchase costs if part X bought	<u>\$1,425</u>

- 20-2 *Costs for determining optimum inventory size.* "Determining the optimum inventory size represents a balancing of opposite costs." What is the meaning of this statement? What specific costs are relevant in such decisions?

- 20-3 *Protective stock margin.* What is the purpose of a protective stock margin, and how should it be established?
- 20-4 *Size of inventory and use of mathematical formulas.* "We have approximately 60,000 different items in our raw materials inventory, purchased from all over the world at varying prices and terms. Under such circumstances how can we possibly apply mathematical techniques in setting our inventory levels?" Comment.
- 20-5 *Limitations to use of mathematics in establishing inventory size.* What are the limitations to the use of mathematical methods in determining optimum inventory size? Can these limitations be overcome?
- 20-6 *Cost of labor turnover.* "Why should we go through the trouble of calculating the cost of labor turnover, when there is little we can do about it?" Do you agree with this statement?
- 20-7 *Meaning of profits lost because of labor turnover.* "Calculating the profit lost because of labor turnover yields an unprecise figure. Besides, profit to an accountant is a residual figure. How can we justify showing it as a cost?"
- 20-8 *Labor turnover cost and profit planning.* Do you believe that the cost of labor turnover should be included in a company's profit plan, and if so, how can standards be established?
- 20-9 *Costs and incoming inspection.* "We have been inspecting all incoming parts 100 percent. Can cost analysis together with statistics assist us in determining whether it is more profitable to inspect less than 100 percent? Can they help us to rate vendors?" Comment.
- 20-10 *Data relevant to location decision.* You are a member of a committee of a large oil company whose function it is to determine where new gas stations should be located. The company has a national network of stations. It also has a limited capital-investment budget. What type of data is required?
- 20-11 *Costs in alternative production decisions.* Exhibit I contains the budgeted operating costs for several processing departments of the Pacific Refining Company. The costs are budgeted at different levels of capacity, 100,000 gallons of throughput representing practical capacity.

In each of the following cases, indicate the appropriate management decision, showing all computations. In each case also assume that the refinery presently is operating at 80 percent of practical capacity.

Case 1. Twenty thousand gallons of fuel oil is on hand. The refinery must decide whether it is more profitable to sell it as fuel oil or to crack it into gasoline. The following additional facts are available:

Cracking yields: 75% gasoline, 15% fuel oil (residual), 10% loss

Current prices: fuel oil 7 cents per gallon, gasoline 14 cents per gallon

Case 2. The refinery can obtain 20,000 gallons of cylinder stock. The usual bargaining process will determine the final price. The refinery management is interested in knowing how high a price it can pay and still make a profit.

The stock purchased would be processed into conventional bright stock and sold as such. The information available is as follows:

Cylinder stock yield: 90% bright stock, 5% petrolatum, 5% loss

Current prices: bright stock, 50 cents per gallon, petrolatum no market



Exhibit I

PACIFIC REFINING COMPANY  
Budgeted Operating Costs

	Shutdown	60%	80%	100%
Throughput, gal.....	-0-	60,000	80,000	100,000
Operating costs:				
Cracking.....	\$3,500	\$8,000	\$9,500	\$10,500
Treating.....	800	1,540	1,800	2,000
Solvent dewaxing.....	1,050	2,800	3,350	3,750
Solvent extraction.....	700	1,900	2,400	2,800
Filtering.....	970	3,720	4,000	4,200

The conversion of cylinder stock into bright stock requires the following operations: solvent dewaxing; solvent extraction; filtering.

Case 3. The refinery has 20,000 gallons of raw kerosene. It can process and sell the kerosene after passing it through the treating department or can crack it for its gasoline content. Additional information is as follows:

- Current prices: kerosene, 8 cents per gallon, fuel oil 7 cents per gallon, gasoline 14 cents a gallon
- Cracking yields: gasoline 85%, residual fuel oil 5%, loss 10%

(Adapted from an article in  
the *NAA Bulletin* by John L. Fox)

20-12 *Plant location.* The Sweet Sugar Company manufactures sugar in 2-pound boxes at its Boston plant. The boxed sugar is sold throughout the country by company salesmen to local food stores. The company has an arrangement in the Middle West with a food distributor, according to which the distributor stores and delivers the sugar to the company's customers, pursuant to shipping instructions. The distributor charges \$.012 per box for this service. Approximately, 20,000,000 pounds of sugar is being shipped to customers in the Middle West.

The company is considering setting up a packing plant in the Middle West and delivering the sugar itself. If this is done, sugar would be shipped in bulk from Boston to the new plant and boxed there.

After a careful survey of available sites, the company is considering two plants that appear equally attractive, one in Clairsville and the other in Wheelton. Both plants have 20,000 square feet, which would be adequate for the company's requirements. Utilities and local taxes are about the same in either location.

The following comparative data have been prepared by the cost accounting department:

- 1. Space costs:
  - Clairsville.....\$1.00 per sq ft
  - Wheelton.....\$1.50 per sq ft
  - Boston—value of space released....\$15,000
- 2. Standard number of boxes packed per hr.....200

## 3. Labor rates per hour:

Clairsville.....	\$2.00
Wheelton.....	\$2.50
Boston.....	\$2.50

## 4. Fringe benefits and payroll taxes.....

20 %

## 5. Variable overhead:

Clairsville.....	\$ .10 per hr
Wheelton.....	\$ .10 per hr
Boston.....	\$ .20 per hr

## 6. Local drayage would cost approximately \$5,000 more at Clairsville than at Wheelton

## 7. Delivery costs:

Clairsville.....	\$ .15 per mile (500,000 miles per year)
Wheelton.....	\$ .12 per mile (450,000 miles per year)

Required: Prepare an exhibit which will indicate to management which of these alternative locations is the more desirable.

20-13

*Shutdown decision.* Quarries, Inc., is engaged in two operations, (1) the quarrying and crushing of stone and (2) the manufacture of concrete blocks. The following are the operating figures for the fiscal year just closed:

	Stone 80,000 tons	30,000 tons	Blocks \$600,000
Sales.....	\$300,000		
Cost of sales:			
Direct labor.....	\$140,000		\$220,000
Cement, sand, etc.....			90,000
Supplies.....	40,000		40,000
Indirect labor.....	40,000		25,000
Power and fuel.....	20,000		45,000
Depreciation—20 % per annum.....	30,000		60,000
Total.....	\$270,000		\$480,000
Transfer—stone used in block-making plant—20,000 tons @ \$3.....	60,000		60,000
Net cost.....	\$210,000		\$540,000
Gross profit.....	\$ 90,000		\$ 60,000
Selling and administrative expense:			
Salesmen's salaries and commissions.....	\$ 30,000		\$ 35,000
Manager's salary and commission.....			11,000
Office salaries and supplies, printing and stationery, telephone and telegraph, and miscellaneous general expenses.			
Total: \$45,000: divided on basis of sales.....	15,000		30,000
Total expenses.....	\$ 45,000		\$ 76,000
Net profit or (loss).....	\$ 45,000		\$ (16,000)

The block-making plant has never made a profit, and the annual losses have varied between \$10,000 and \$30,000. Some of the directors feel that the activities of this department should be discontinued and the plant dismantled, but others disagree. Before making a final decision, they ask for your advice.

From the financial and accounting point of view, the effects of a decision to close down may be summarized as follows:

1. About 50 percent of the crushed stone now being used in the block plant could be sold at \$2.50 per ton, subject to a 15 percent commission to salesmen. The transfer figure of \$3 used in the statement is an arbitrary one for the purpose of arriving at departmental results.
2. The plant and equipment used in the block plant cost \$300,000, and, including the year just closed, the reserve for depreciation is \$180,000. It is estimated that, if dismantled and sold, the plant might realize \$60,000.
3. It is expected that administrative expense, now \$45,000 per annum, might be reduced to \$25,000 per annum.
4. The remuneration to the manager of the block plant is \$5,000 per annum, plus 10 percent of the gross profit. His contract still has 3 years to run, and he has indicated that he would hold the company to its terms but that in addition to his salary he would agree to a round figure of \$5,000 per annum as representing a fair estimate of the portion of profits to which he would normally be entitled.
5. Any fluctuation in production of crushed stone would have a pro rata effect on the cost of direct labor, supplies, power, and fuel; other manufacturing expenses would not be affected.

*Required:* Prepare a schedule for the board of directors which will show the economic desirability of closing the block plant during the coming year. Interest on fixed assets used at the block plant is to be computed at 10 percent. Tax considerations are to be ignored.

(CCA adapted)

- 20-14 The A.B.C. Motor Company has a branch factory on Long Island in which certain of the automobile parts are made. The factory was erected on leased land at a cost, including machinery, of \$500,000. The funds for this were

Raw materials purchases.....	\$ 30,000.00	
Raw materials transferred from stores.....		\$ 40,000.00
Factory labor, direct.....	80,000.00	
Rent.....	8,000.00	
Bond interest (5% on \$100,000).....	5,000.00	
Real estate taxes.....	6,000.00	
Amortization of bond discount.....	5,000.00	
Insurance, fire.....	4,000.00	
Repairs.....	5,000.00	
Miscellaneous expenses.....	17,000.00	
Depreciation.....	20,000.00	
Raw materials inventory, beginning of year.....	60,000.00	
In-process inventory, beginning of year.....	30,000.00	
Transfers from raw materials stores.....	40,000.00	
Transfers to main factory (1,000,000 units of finished goods).....		200,000.00
Main factory.....		70,000.00
	<u>\$310,000.00</u>	<u>\$310,000.00</u>

obtained on a serial debenture bond issue. Subsequently, additions to the plant were made with funds provided by a stock issue. A trial balance of the branch factory ledger at the end of last year is shown on page 660.

The operating results for the last year may be regarded as typical.

The allowance for depreciation at the end of the year for the branch plant and equipment amounted to \$300,000. The annual depreciation of \$20,000 is sufficient to wipe out the cost of the plant and the equipment in 10 years, the date of expiration of the lease. The book value of the plant and equipment is believed to be about equal to market value. The annual charge of \$5,000 for amortization of bond discount is sufficient to wipe out the deferred charge (which had a balance of \$50,000 at the end of the year) by the date the bonds are to be paid off.

It has been proposed to the board of directors that the parts be purchased from a reliable parts manufacturer at a price, guaranteed by him for a long term, of 19.5 cents each. This manufacturer will also take over the lease and purchase of the plant at book value and the inventories at factory cost (in accordance with accepted accounting standards).

Prepare an exhibit for the board of directors which will indicate to them whether, at the end of the lease, the company would be better off financially if it continued as at present or if it adopted the above-mentioned proposal. The board advises you that they can invest money at 5 percent per annum. The future value of \$1 compounded annually at 5 percent for 10 years is \$1.629.

(New York CPA adapted)

**20-15** *Make or buy decision.* Included among the products of the Soap Company is a spray disinfectant. The product is sold in a metal container which weighs .55 pound when filled. The disinfectant at present is being manufactured by a firm located in Indianapolis, Ind., and shipped to the Soap Company's four warehouses at a price of \$2.70 per dozen, f.o.b. Indianapolis.

Prior to the last 2 years, the Soap Company acted exclusively as a distributor. However, 2 years ago it constructed a plant adjacent to its Trenton warehouse for the purpose of manufacturing several items that it had been purchasing for resale. The management of the Soap Company now is considering the desirability of manufacturing the spray disinfectant at its Trenton plant. It is willing to do so if it can obtain a 20 percent pretax return on the required investment.

The company's management believes that the space needed to produce the disinfectant is worth \$20,000 a year. However, the comptroller has prepared an exhibit which shows that, if a proportionate share of the building costs were allocated to the proposed spray disinfectant department, the total would amount to only \$14,000 a year. Filling machines and other equipment needed are estimated to cost \$190,000 and to have 15-year lives. It also is estimated that the average annual inventories will be increased by \$40,000. Direct labor is estimated at \$13.68 per thousand cans. Repairs and maintenance of machinery and equipment are expected to amount to \$15,800 per annum. Other variable overhead directly related to the proposed operation is estimated at \$2.32 per thousand cans and allocated home-office expenses applicable to the spray disinfectant department at \$2 per thousand cans. Materials costs per thousand units are estimated as follows:



Perfume.....	\$ 8.21
Mineral spirits.....	4.05
Propellant.....	66.22
Cans.....	38.84
Caps.....	15.60
Valves.....	27.30
Pads.....	.60
Cases.....	4.81
Miscellaneous.....	.19
	<u>\$165.82</u>

Shipments are expected to remain at about the same level as at present during the foreseeable future. During the past year, the manufacturer of the disinfectant has made the following shipments to company warehouses:

	<i>Dozen cans</i>
Trenton warehouse.....	60,000
Warehouse 2.....	50,000
Warehouse 3.....	37,500
Warehouse 4.....	20,000
	<u>167,500</u>

Freight rates per hundredweight are as follows:

	<i>Trenton</i>	<i>Warehouse 2</i>	<i>Warehouse 3</i>	<i>Warehouse 4</i>
From Indianapolis.....	\$ .65	\$ .50	\$1.05	\$2.60
From Trenton.....	—0—	1.25	1.45	2.75

*Required:* Should the company manufacture the spray disinfectant?

**20-16** *Cost of labor turnover.* The Reliable Machine Products Corporation manufactures special purpose tools and dies. The company's income statement for the year ended December 31, 1962, appears in Exhibit I. Inventories of work in process and finished goods were approximately the same at the beginning and end of the year.

Although the company had a backlog of unfilled orders during most of 1962, its sales and profits had declined significantly in comparison with the prior year.

A sharp rise in labor turnover took place in 1962, and included among the variable factory-overhead costs was \$150,000, representing the direct cost of factory labor turnover, i.e., separation, recruitment, selection, and training. It was believed that the rise in labor turnover was a major factor in the poor results obtained.

The fabrication of the company's products requires a high degree of skill. Consequently, all direct laborers are required to complete a 3-week training program. The salaries of trainees are charged to direct labor. In aggregate, 42,000 hours were devoted to training replacements for direct laborers who had quit or been discharged during the year. Approximately one-third of the



## Exhibit I

## RELIABLE MACHINE PRODUCTS CORPORATION

## Income Statement

For the Year Ended December 31, 1962

Sales.....		<u>\$8,000,000</u>
Less: Variable costs		
Materials.....		\$2,100,000
Direct labor (480,000 @ \$2.50).....		1,200,000
Variable factory overhead.....		1,100,000
Variable selling and administrative expense....		400,000
Total variable costs.....		<u>\$4,800,000</u>
Contribution to fixed costs and profit.....		\$3,200,000
Less: Fixed overhead		
Factory.....	\$1,200,000	
Selling and administrative.....	1,700,000	2,900,000
Profit before income tax.....		<u>\$ 300,000</u>

training time resulted in acceptable production. It was estimated that, in addition to training time, 50,000 hours of potential direct labor was lost because of delays in securing replacements for separteers.

After examining the various causes for the turnover in labor, the personnel manager recommended a program for reducing the turnover. He estimated that his recommendations would reduce the turnover by 50 percent but would cost approximately \$200,000. The president stated that it hardly seemed profitable to spend \$200,000 in order to save \$75,000, i.e., one-half of the direct cost of labor turnover.

*Required:* Was the president correct?

20-17 *Optimum inventory size.* In January, 1962, Peter Arnet, manager of purchasing for Metal-Fab, Inc., received the following memo from the president:

"Our auditor has called my attention to the fact that the turnover of our Raw Materials Inventory, in relation to annual usage, has declined from 10 turns in 1960 to 5 turns in 1961. He points out that this is a serious matter since it ties up capital that could be profitably used elsewhere and invites unnecessary losses through scrap and obsolescence. I want you to set up a procedure that will assure our obtaining a Raw Materials Inventory turnover of at least 10 times this year."

Approximately 80 percent of the value of the Raw Materials Inventory consists of three classes of items, I, II, and III. It may be assumed that the nature of the individual items within each class is essentially similar. During 1961, the average inventory value of these three classes was \$250,000 and the total annual usage \$1,250,000. It is the company's policy to maintain a protective margin for these three classes of items equal to 10 percent of their annual usage and to order additional materials as the need manifests itself. The remaining 20 percent of the Raw Materials Inventory value may be ignored, since it consisted of a large number of small items for which it is possible to maintain a high margin of protective stock.

The following data are relevant to classes I, II, and III raw materials:

	<i>Class I</i>	<i>Class II</i>	<i>Class III</i>
Number of items in class .....	20	15	50
Average annual requirements per item .....	\$10,000	\$30,000	\$12,000
Inventory carrying costs (as percentage of the inventory value)			
Fixed:			
Insurance and taxes .....	1.0	1.0	1.0
Space costs .....	2.0	2.0	3.0
Depreciation of material handling equipment .....	1.0	1.0	1.0
Variable:			
Interest on investment .....	6.0	6.0	6.0
Scrap and obsolescence .....	4.0	6.0	7.0
Material handling .....	2.0	3.0	3.0
Total .....	16.0	19.0	21.0
Order-handling costs (per order)			
Fixed:			
Space costs .....	\$ .10	\$ .10	\$ .10
Supervision .....	.50	.50	.50
Variable:			
Purchasing .....	3.50	2.00	2.40
Receiving and inspection .....	1.50	1.40	1.60
Materials planning .....	.50	.30	.50
Accounts payable .....	.50	.30	.50
Total .....	\$6.60	\$4.60	\$5.60

*Required:*

1. In general, do you agree with the views of the president and auditor?
2. Using a mathematical formula, what turnover rate would have maximized profits in 1961?
3. What limitations are there to the use of a formula method for establishing optimum inventory size?

## **Appendix: Interest Tables**

Table I Present Value of \$1 Received Annually for n Years\*

Years (n)	1%	2%	4%	6%	8%	10%	12%	14%	15%	16%	18%	20%	22%	24%	25%	26%	28%	30%	35%	40%	45%	50%
1	\$0.990	\$0.980	\$0.962	\$0.943	\$0.926	\$0.909	\$0.893	\$0.877	\$0.870	\$0.862	\$0.847	\$0.833	\$0.820	\$0.806	\$0.800	\$0.794	\$0.781	\$0.769	\$0.741	\$0.714	\$0.690	\$0.667
2	1.970	1.942	1.886	1.833	1.783	1.736	1.690	1.647	1.626	1.605	1.566	1.528	1.492	1.457	1.440	1.424	1.392	1.361	1.289	1.224	1.165	1.111
3	2.941	2.884	2.775	2.673	2.577	2.487	2.402	2.322	2.285	2.246	2.174	2.106	2.042	1.981	1.952	1.923	1.868	1.816	1.696	1.589	1.493	1.407
4	3.902	3.808	3.630	3.465	3.312	3.170	3.037	2.914	2.855	2.798	2.690	2.589	2.494	2.401	2.362	2.320	2.241	2.166	1.997	1.849	1.720	1.605
5	4.853	4.713	4.452	4.212	3.993	3.791	3.605	3.433	3.352	3.274	3.127	2.991	2.864	2.745	2.689	2.635	2.532	2.436	2.220	2.035	1.876	1.737
6	5.795	5.601	5.242	4.917	4.623	4.355	4.111	3.889	3.784	3.685	3.498	3.326	3.167	3.020	2.951	2.885	2.759	2.643	2.385	2.168	1.983	1.824
7	6.728	6.472	6.002	5.582	5.206	4.868	4.564	4.288	4.160	4.039	3.812	3.605	3.416	3.242	3.161	3.083	2.937	2.802	2.508	2.263	2.057	1.883
8	7.652	7.325	6.733	6.210	5.747	5.335	4.968	4.639	4.487	4.344	4.078	3.837	3.619	3.421	3.329	3.241	3.076	2.925	2.598	2.331	2.108	1.922
9	8.566	8.162	7.435	6.802	6.247	5.759	5.328	4.946	4.772	4.607	4.303	4.031	3.786	3.566	3.463	3.366	3.184	3.019	2.665	2.379	2.144	1.948
10	9.471	8.983	8.111	7.360	6.710	6.145	5.650	5.216	5.019	4.833	4.494	4.192	3.923	3.682	3.571	3.465	3.269	3.092	2.715	2.414	2.168	1.965
11	10.368	9.787	8.760	7.887	7.139	6.495	5.937	5.453	5.234	5.029	4.656	4.327	4.035	3.776	3.656	3.544	3.335	3.137	2.752	2.438	2.185	1.977
12	11.255	10.575	9.385	8.384	7.536	6.814	6.194	5.660	5.421	5.197	4.793	4.439	4.127	3.851	3.725	3.606	3.387	3.190	2.779	2.456	2.196	1.985
13	12.134	11.343	9.986	8.853	7.904	7.103	6.424	5.842	5.583	5.342	4.910	4.533	4.203	3.912	3.780	3.656	3.427	3.223	2.799	2.468	2.204	1.990
14	13.004	12.106	10.563	9.295	8.244	7.367	6.628	6.002	5.724	5.468	5.008	4.611	4.265	3.962	3.824	3.695	3.459	3.249	2.814	2.477	2.210	1.993
15	13.865	12.849	11.118	9.712	8.559	7.606	6.811	6.142	5.847	5.575	5.092	4.675	4.315	4.001	3.859	3.726	3.483	3.268	2.825	2.484	2.214	1.995
16	14.718	13.578	11.652	10.106	8.851	7.824	6.974	6.265	5.954	5.669	5.162	4.730	4.357	4.033	3.887	3.751	3.503	3.283	2.834	2.489	2.216	1.997
17	15.562	14.292	12.166	10.477	9.122	8.022	7.120	6.373	6.037	5.749	5.222	4.775	4.391	4.059	3.910	3.771	3.518	3.295	2.840	2.492	2.218	1.998
18	16.398	14.992	12.659	10.828	9.372	8.201	7.250	6.467	6.128	5.818	5.273	4.812	4.419	4.080	3.928	3.786	3.529	3.304	2.844	2.494	2.219	1.999
19	17.226	15.678	13.134	11.158	9.604	8.365	7.366	6.550	6.198	5.877	5.316	4.844	4.442	4.097	3.942	3.799	3.539	3.311	2.846	2.496	2.221	1.999
20	18.046	16.351	13.590	11.470	9.818	8.514	7.469	6.623	6.259	5.929	5.353	4.870	4.460	4.110	3.954	3.808	3.546	3.316	2.850	2.497	2.221	1.999
21	18.857	17.011	14.029	11.764	10.017	8.649	7.562	6.687	6.312	5.973	5.384	4.891	4.476	4.121	3.963	3.816	3.551	3.320	2.852	2.498	2.221	2.000
22	19.660	17.658	14.451	12.042	10.201	8.772	7.645	6.743	6.359	6.011	5.410	4.909	4.488	4.130	3.970	3.822	3.556	3.323	2.853	2.498	2.222	2.000
23	20.456	18.292	14.857	12.303	10.371	8.883	7.718	6.792	6.399	6.044	5.432	4.925	4.499	4.137	3.976	3.827	3.559	3.325	2.854	2.499	2.222	2.000
24	21.243	18.914	15.247	12.550	10.529	8.985	7.784	6.835	6.434	6.073	5.451	4.937	4.507	4.143	3.981	3.831	3.562	3.327	2.855	2.499	2.222	2.000
25	22.023	19.523	15.622	12.783	10.675	9.077	7.843	6.873	6.464	6.097	5.467	4.948	4.514	4.147	3.985	3.834	3.564	3.329	2.856	2.499	2.222	2.000
26	22.795	20.121	15.983	13.003	10.810	9.161	7.896	6.906	6.491	6.118	5.480	4.956	4.520	4.151	3.988	3.837	3.566	3.330	2.856	2.500	2.222	2.000
27	23.560	20.707	16.330	13.211	10.935	9.237	7.943	6.935	6.514	6.136	5.492	4.964	4.524	4.154	3.990	3.839	3.567	3.331	2.856	2.500	2.222	2.000
28	24.316	21.281	16.663	13.406	11.051	9.307	7.984	6.961	6.534	6.152	5.502	4.970	4.528	4.157	3.992	3.840	3.568	3.332	2.857	2.500	2.222	2.000
29	25.066	21.844	16.984	13.591	11.158	9.370	8.022	6.983	6.551	6.166	5.510	4.975	4.531	4.159	3.994	3.841	3.569	3.332	2.857	2.500	2.222	2.000
30	25.808	22.396	17.292	13.765	11.258	9.427	8.055	7.003	6.566	6.177	5.517	4.979	4.534	4.160	3.995	3.842	3.569	3.332	2.857	2.500	2.222	2.000
40	32.835	27.355	19.793	15.046	11.925	9.779	8.244	7.105	6.642	6.234	5.548	4.997	4.544	4.166	3.999	3.846	3.571	3.333	2.857	2.500	2.222	2.000
50	39.196	31.424	21.482	15.762	12.234	9.915	8.304	7.133	6.661	6.246	5.554	4.999	4.545	4.167	4.000	3.846	3.571	3.333	2.857	2.500	2.222	2.000

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Table II Present Value of \$1\*

Years hence	1%	2%	4%	6%	8%	10%	12%	14%	15%	16%	18%	20%	22%	24%	25%	26%	28%	30%	35%	40%	45%	50%
1	\$0.990	\$0.980	\$0.962	\$0.943	\$0.926	\$0.909	\$0.893	\$0.877	\$0.870	\$0.862	\$0.847	\$0.833	\$0.820	\$0.806	\$0.800	\$0.794	\$0.781	\$0.769	\$0.741	\$0.714	\$0.690	\$0.667
2	0.980	0.961	0.925	0.890	0.857	0.826	0.797	0.769	0.756	0.743	0.718	0.694	0.672	0.650	0.640	0.630	0.610	0.592	0.549	0.510	0.476	0.444
3	0.971	0.942	0.889	0.840	0.794	0.751	0.712	0.675	0.658	0.641	0.609	0.579	0.551	0.524	0.512	0.500	0.477	0.455	0.406	0.364	0.328	0.296
4	0.961	0.924	0.855	0.792	0.735	0.683	0.636	0.592	0.572	0.552	0.516	0.482	0.451	0.423	0.410	0.397	0.373	0.350	0.301	0.260	0.226	0.198
5	0.951	0.906	0.822	0.747	0.681	0.621	0.567	0.519	0.497	0.476	0.437	0.402	0.370	0.341	0.328	0.315	0.291	0.269	0.223	0.186	0.156	0.132
6	0.942	0.888	0.790	0.705	0.630	0.564	0.507	0.456	0.432	0.410	0.370	0.335	0.303	0.275	0.262	0.250	0.227	0.207	0.165	0.133	0.108	0.088
7	0.933	0.871	0.760	0.665	0.583	0.513	0.452	0.400	0.376	0.354	0.314	0.279	0.249	0.222	0.210	0.198	0.178	0.159	0.122	0.095	0.074	0.059
8	0.923	0.853	0.731	0.627	0.540	0.467	0.404	0.351	0.327	0.305	0.266	0.233	0.204	0.179	0.168	0.157	0.139	0.123	0.091	0.068	0.051	0.039
9	0.914	0.837	0.703	0.592	0.500	0.424	0.361	0.308	0.284	0.263	0.225	0.194	0.167	0.144	0.134	0.125	0.108	0.094	0.067	0.048	0.035	0.026
10	0.905	0.820	0.676	0.558	0.463	0.386	0.322	0.270	0.247	0.227	0.191	0.162	0.137	0.116	0.107	0.099	0.085	0.073	0.050	0.035	0.024	0.017
11	0.896	0.804	0.650	0.527	0.429	0.350	0.287	0.237	0.215	0.195	0.162	0.135	0.112	0.094	0.086	0.079	0.066	0.056	0.037	0.025	0.017	0.012
12	0.887	0.788	0.625	0.497	0.397	0.319	0.257	0.208	0.187	0.168	0.137	0.112	0.092	0.076	0.069	0.062	0.052	0.043	0.027	0.018	0.012	0.008
13	0.879	0.773	0.601	0.469	0.368	0.290	0.229	0.182	0.163	0.145	0.116	0.093	0.075	0.061	0.055	0.050	0.040	0.033	0.020	0.013	0.008	0.005
14	0.870	0.758	0.577	0.442	0.340	0.263	0.205	0.160	0.141	0.125	0.099	0.078	0.062	0.049	0.044	0.039	0.032	0.025	0.015	0.009	0.006	0.003
15	0.861	0.743	0.555	0.417	0.315	0.239	0.183	0.140	0.123	0.108	0.084	0.065	0.051	0.040	0.035	0.031	0.025	0.020	0.011	0.006	0.004	0.002
16	0.853	0.728	0.534	0.394	0.292	0.218	0.163	0.123	0.107	0.093	0.071	0.054	0.042	0.032	0.028	0.025	0.019	0.015	0.008	0.005	0.003	0.002
17	0.844	0.714	0.513	0.371	0.270	0.198	0.146	0.108	0.093	0.080	0.060	0.045	0.034	0.026	0.023	0.020	0.015	0.012	0.006	0.003	0.002	0.001
18	0.836	0.700	0.494	0.350	0.250	0.180	0.130	0.095	0.081	0.069	0.051	0.038	0.028	0.021	0.018	0.016	0.012	0.009	0.005	0.002	0.001	0.001
19	0.828	0.686	0.475	0.331	0.232	0.164	0.116	0.083	0.070	0.060	0.043	0.031	0.023	0.017	0.014	0.012	0.009	0.007	0.003	0.002	0.001	0.001
20	0.820	0.673	0.456	0.312	0.215	0.149	0.104	0.073	0.061	0.051	0.037	0.026	0.019	0.014	0.012	0.010	0.007	0.005	0.002	0.001	0.001	0.001
21	0.811	0.660	0.439	0.294	0.199	0.135	0.093	0.064	0.053	0.044	0.031	0.022	0.015	0.011	0.009	0.008	0.006	0.004	0.002	0.001	0.001	0.001
22	0.803	0.647	0.422	0.278	0.184	0.123	0.083	0.056	0.046	0.038	0.026	0.018	0.013	0.009	0.007	0.006	0.004	0.003	0.001	0.001	0.001	0.001
23	0.795	0.634	0.406	0.262	0.170	0.112	0.074	0.049	0.040	0.033	0.022	0.015	0.010	0.007	0.006	0.005	0.003	0.002	0.001	0.001	0.001	0.001
24	0.788	0.622	0.390	0.247	0.158	0.102	0.066	0.043	0.035	0.028	0.019	0.013	0.008	0.006	0.005	0.004	0.003	0.002	0.001	0.001	0.001	0.001
25	0.780	0.610	0.375	0.233	0.146	0.092	0.059	0.038	0.030	0.024	0.016	0.010	0.007	0.005	0.004	0.003	0.002	0.001	0.001	0.001	0.001	0.001
26	0.772	0.598	0.361	0.220	0.135	0.084	0.053	0.033	0.026	0.021	0.014	0.009	0.006	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001
27	0.764	0.586	0.347	0.207	0.125	0.076	0.047	0.029	0.023	0.018	0.011	0.007	0.005	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001
28	0.757	0.574	0.333	0.196	0.116	0.069	0.042	0.026	0.020	0.016	0.010	0.006	0.004	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001
29	0.749	0.563	0.321	0.185	0.107	0.063	0.037	0.022	0.017	0.014	0.008	0.005	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001
30	0.742	0.552	0.308	0.174	0.099	0.057	0.033	0.020	0.015	0.012	0.007	0.004	0.003	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
40	0.672	0.453	0.208	0.097	0.046	0.022	0.011	0.005	0.004	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
50	0.608	0.372	0.141	0.054	0.021	0.009	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

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Table IV Capital-recovery Factor

Years	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%
1	\$1.0100	\$1.0200	\$1.0300	\$1.0400	\$1.0500	\$1.0600	\$1.0700	\$1.0800	\$1.0900	\$1.1000	\$1.1100	\$1.1200	\$1.1300	\$1.1400	\$1.1500	\$1.1600	\$1.1700	\$1.1800	\$1.1900	\$1.2000
2	.5076	.5155	.5226	.5305	.5376	.5455	.5529	.5606	.5685	.5760	.5839	.5917	.5994	.6074	.6150	.6231	.6308	.6388	.6467	.6545
3	.3401	.3466	.3534	.3604	.3671	.3741	.3811	.3880	.3951	.4021	.4092	.4164	.4236	.4308	.4380	.4453	.4526	.4599	.4673	.4747
4	.2564	.2625	.2691	.2755	.2820	.2886	.2952	.3019	.3086	.3155	.3223	.3292	.3362	.3432	.3503	.3574	.3646	.3717	.3790	.3863
5	.2062	.2121	.2183	.2246	.2309	.2374	.2439	.2505	.2571	.2638	.2706	.2774	.2843	.2913	.2983	.3054	.3126	.3198	.3270	.3344
6	.1724	.1786	.1846	.1907	.1970	.2034	.2098	.2163	.2229	.2296	.2364	.2432	.2501	.2572	.2642	.2714	.2786	.2859	.2933	.3007
7	.1486	.1546	.1605	.1666	.1728	.1792	.1855	.1921	.1987	.2054	.2122	.2191	.2261	.2332	.2403	.2476	.2549	.2624	.2698	.2774
8	.1307	.1365	.1425	.1485	.1547	.1610	.1675	.1740	.1807	.1874	.1943	.2013	.2084	.2156	.2228	.2302	.2377	.2452	.2529	.2606
9	.1167	.1225	.1284	.1345	.1407	.1470	.1535	.1601	.1668	.1736	.1806	.1877	.1949	.2022	.2096	.2171	.2247	.2324	.2402	.2481
10	.1056	.1113	.1172	.1233	.1295	.1359	.1424	.1490	.1558	.1627	.1698	.1770	.1843	.1917	.1993	.2069	.2146	.2225	.2305	.2385
11	.0964	.1022	.1081	.1142	.1204	.1268	.1334	.1401	.1469	.1540	.1611	.1684	.1758	.1834	.1911	.1989	.2068	.2148	.2229	.2311
12	.0888	.0946	.1005	.1066	.1128	.1193	.1259	.1327	.1396	.1468	.1540	.1614	.1690	.1767	.1845	.1924	.2005	.2086	.2169	.2253
13	.0824	.0881	.0940	.1002	.1065	.1130	.1197	.1265	.1336	.1408	.1481	.1557	.1634	.1712	.1791	.1872	.1954	.2037	.2121	.2206
14	.0769	.0826	.0885	.0947	.1010	.1076	.1143	.1213	.1284	.1357	.1432	.1509	.1587	.1666	.1747	.1829	.1912	.1997	.2082	.2169
15	.0721	.0778	.0836	.0899	.0963	.1030	.1098	.1168	.1241	.1315	.1391	.1468	.1547	.1628	.1710	.1794	.1878	.1964	.2051	.2139
16	.0679	.0736	.0796	.0858	.0923	.0989	.1059	.1130	.1203	.1278	.1355	.1434	.1514	.1596	.1680	.1764	.1850	.1937	.2025	.2114
17	.0643	.0700	.0759	.0822	.0887	.0955	.1024	.1096	.1171	.1247	.1325	.1404	.1486	.1569	.1654	.1740	.1827	.1915	.2004	.2094
18	.0610	.0667	.0727	.0790	.0855	.0924	.0994	.1067	.1142	.1219	.1298	.1379	.1462	.1546	.1632	.1719	.1807	.1896	.1987	.2078
19	.0580	.0638	.0698	.0761	.0827	.0896	.0968	.1041	.1117	.1195	.1276	.1358	.1441	.1527	.1613	.1701	.1791	.1881	.1972	.2065
20	.0554	.0612	.0672	.0736	.0802	.0872	.0944	.1018	.1095	.1175	.1256	.1339	.1424	.1510	.1598	.1687	.1777	.1868	.1960	.2054
21	.0530	.0588	.0649	.0713	.0780	.0850	.0923	.0998	.1076	.1156	.1238	.1322	.1408	.1495	.1584	.1674	.1765	.1857	.1951	.2044
22	.0509	.0566	.0627	.0692	.0760	.0830	.0904	.0980	.1059	.1140	.1223	.1308	.1395	.1483	.1573	.1664	.1755	.1848	.1942	.2037
23	.0489	.0547	.0608	.0673	.0741	.0813	.0887	.0964	.1044	.1126	.1210	.1296	.1383	.1472	.1563	.1654	.1747	.1841	.1935	.2031
24	.0471	.0529	.0590	.0656	.0725	.0797	.0872	.0950	.1030	.1113	.1198	.1285	.1373	.1463	.1554	.1647	.1740	.1834	.1930	.2026
25	.0454	.0512	.0574	.0640	.0710	.0782	.0858	.0937	.1018	.1102	.1187	.1275	.1364	.1455	.1547	.1640	.1734	.1829	.1925	.2021

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Table IV Capital-recovery Factor—(Continued)

Years	1 %	2 %	3 %	4 %	5 %	6 %	7 %	8 %	9 %	10 %	11 %	12 %	13 %	14 %	15 %	16 %	17 %	18 %	19 %	20 %
26	.0439	.0497	.0559	.0626	.0696	.0769	.0846	.0925	.1007	.1092	.1178	.1266	.1357	.1448	.1541	.1634	.1729	.1825	.1921	.2018
27	.0424	.0483	.0546	.0612	.0683	.0757	.0834	.0914	.0997	.1083	.1170	.1259	.1350	.1442	.1535	.1630	.1725	.1821	.1917	.2015
28	.0411	.0470	.0533	.0600	.0671	.0746	.0824	.0905	.0988	.1074	.1163	.1252	.1344	.1437	.1531	.1626	.1721	.1818	.1915	.2012
29	.0399	.0458	.0521	.0589	.0660	.0736	.0815	.0896	.0981	.1067	.1156	.1247	.1339	.1432	.1527	.1622	.1718	.1815	.1912	.2010
30	.0387	.0447	.0510	.0578	.0651	.0726	.0806	.0888	.0973	.1061	.1150	.1241	.1334	.1428	.1523	.1619	.1715	.1813	.1910	.2008
31	.0377	.0436	.0500	.0569	.0641	.0718	.0798	.0881	.0967	.1055	.1145	.1237	.1330	.1425	.1520	.1616	.1713	.1811	.1909	.2007
32	.0367	.0426	.0490	.0560	.0633	.0710	.0791	.0875	.0961	.1050	.1140	.1233	.1327	.1421	.1517	.1614	.1711	.1809	.1907	.2006
33	.0357	.0417	.0482	.0551	.0625	.0703	.0784	.0869	.0956	.1045	.1136	.1229	.1323	.1419	.1515	.1612	.1710	.1808	.1906	.2005
34	.0348	.0408	.0473	.0543	.0618	.0696	.0778	.0863	.0951	.1041	.1133	.1226	.1321	.1416	.1513	.1610	.1708	.1807	.1905	.2004
35	.0340	.0400	.0465	.0536	.0611	.0690	.0772	.0858	.0946	.1037	.1129	.1223	.1318	.1414	.1511	.1609	.1707	.1805	.1904	.2003
36	.0332	.0392	.0458	.0529	.0604	.0684	.0767	.0853	.0942	.1033	.1126	.1221	.1316	.1413	.1510	.1608	.1706	.1805	.1904	.2003
37	.0325	.0385	.0451	.0522	.0598	.0679	.0762	.0849	.0939	.1030	.1124	.1218	.1314	.1411	.1509	.1607	.1705	.1804	.1903	.2002
38	.0318	.0378	.0445	.0516	.0593	.0674	.0758	.0845	.0935	.1027	.1121	.1216	.1313	.1410	.1507	.1606	.1704	.1803	.1902	.2002
39	.0311	.0372	.0438	.0511	.0588	.0669	.0754	.0842	.0932	.1025	.1119	.1215	.1311	.1408	.1506	.1605	.1704	.1803	.1902	.2002
40	.0305	.0366	.0433	.0505	.0583	.0665	.0750	.0839	.0930	.1023	.1117	.1213	.1310	.1407	.1506	.1604	.1703	.1802	.1902	.2001
41	.0299	.0360	.0427	.0500	.0578	.0661	.0747	.0836	.0927	.1021	.1116	.1212	.1309	.1406	.1505	.1604	.1703	.1802	.1902	.2001
42	.0293	.0354	.0422	.0495	.0574	.0657	.0743	.0833	.0925	.1019	.1114	.1210	.1308	.1406	.1504	.1603	.1702	.1802	.1901	.2001
43	.0287	.0349	.0417	.0491	.0570	.0653	.0740	.0830	.0923	.1017	.1112	.1209	.1307	.1405	.1504	.1603	.1702	.1801	.1901	.2001
44	.0282	.0344	.0412	.0487	.0566	.0650	.0738	.0828	.0921	.1015	.1111	.1208	.1306	.1404	.1503	.1602	.1702	.1801	.1901	.2001
45	.0277	.0339	.0408	.0483	.0563	.0647	.0735	.0826	.0919	.1014	.1110	.1207	.1305	.1404	.1503	.1602	.1702	.1801	.1901	.2001
46	.0272	.0335	.0404	.0479	.0559	.0644	.0733	.0824	.0917	.1013	.1109	.1207	.1305	.1403	.1502	.1602	.1701	.1801	.1901	.2000
47	.0268	.0330	.0400	.0475	.0556	.0642	.0730	.0822	.0916	.1011	.1108	.1206	.1304	.1403	.1502	.1601	.1701	.1801	.1901	.2000
48	.0263	.0326	.0396	.0472	.0553	.0639	.0728	.0820	.0915	.1010	.1107	.1205	.1304	.1403	.1502	.1601	.1701	.1801	.1900	.2000
49	.0259	.0322	.0392	.0469	.0550	.0637	.0726	.0819	.0913	.1009	.1107	.1205	.1303	.1402	.1502	.1601	.1701	.1801	.1900	.2000
50	.0255	.0318	.0389	.0465	.0548	.0634	.0725	.0817	.0912	.1009	.1106	.1204	.1303	.1402	.1501	.1601	.1701	.1801	.1900	.2000

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